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E. W. NELSON, *Chief*

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LIFE ZONE INVESTIGATIONS IN WYOMING

BY

MERRITT CARY

ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

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(Continued on page 3 of cover.)

Longitude West from Greenwich

MONTANA

SOUTH DAKOTA

NEBRASKA

UTAH

COLORADO

LIFE ZONES OF WYOMING

BY MERRITT CARY, ASSISTANT BIOLOGIST

BIOLOGICAL SURVEY, U.S. DEPARTMENT OF AGRICULTURE

- ARCTIC-ALPINE ZONE
- HUDSONIAN ZONE
- CANADIAN ZONE
- TRANSITION ZONE
- UPPER SONORAN ZONE

Scale of Miles

10 0 10 20 30 40 50

Longitude West from Washington

TO ACCOMPANY
REPORT ON LIFE ZONES OF WYOMING
NORTH AMERICAN FAUNA No. 42
1917

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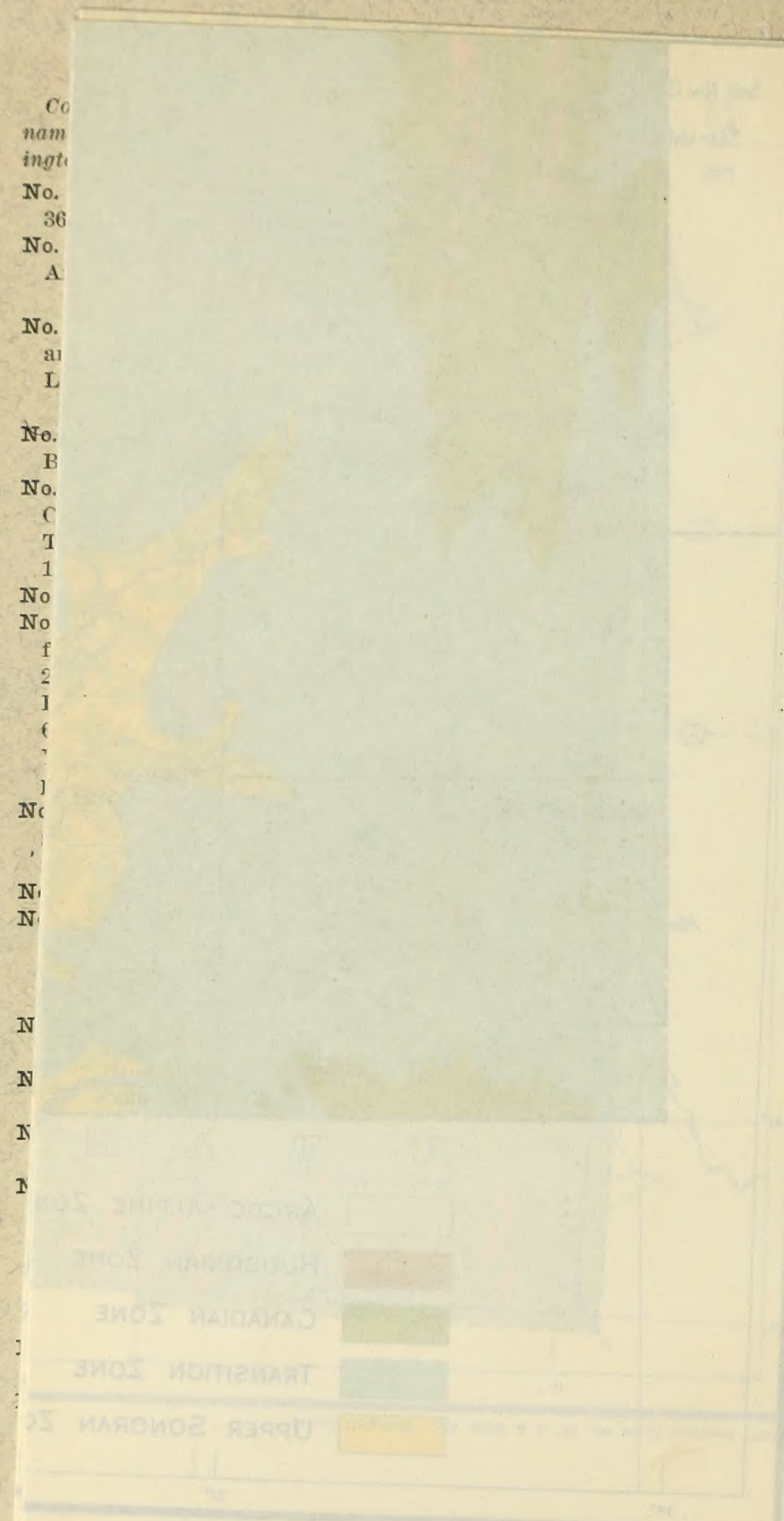

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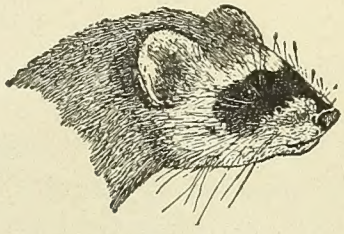

LIFE ZONE INVESTIGATIONS IN WYOMING

BY

MERRITT CARY

ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., November 23, 1916.

SIR: I have the honor to transmit for publication as North American Fauna No. 42, a report on life zone investigations in Wyoming, by Merritt Cary, Assistant Biologist of the Biological Survey. The report is based on the results of natural history explorations conducted in recent years by Survey field parties in all the important physiographic areas of the State. The first section characterizes the five transcontinental life zones represented in Wyoming, defines their extent and limits, and discusses their economic possibilities. The second consists of notes on the distribution and abundance of conspicuous trees and shrubs observed during the progress of the survey. Of particular importance in connection with this report, as well as with others yet to be made on the distribution of the birds and mammals of Wyoming, is the accompanying map, which shows in detail the extent and boundaries of the life zones which traverse the State.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

Hon. DAVID F. HOUSTON,
Secretary of Agriculture.

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No. 42. NORTH AMERICAN FAUNA. Oct., 1917.

LIFE ZONE INVESTIGATIONS IN WYOMING.

By Merritt Cary.

INTRODUCTION.

Wyoming is among the foremost of our States in its wealth of natural scenery, culminating in the grandeur of Yellowstone National Park, one of the wonders of the world. In addition to this distinction it posseses vast open plains and lofty mountains whence flow the headwaters of mighty river systems emptying far away to the west into the Pacific Ocean, to the southeast into the Gulf of Mexico, and to the southwest into the Gulf of California. The various slope exposures of its mountain ranges, the fertility of its intervening valleys or basins, and the aridity of its desert spaces present a study of geographic and vertical distribution of wild life that is in many particulars unique.

The study of geographic and vertical distribution of life with the governing factors and attendant problems is valuable as a matter of scientific research and in the attainment of practical knowledge. The Biological Survey has been making detailed investigations of the transcontinental life belts, or zones, of North America for some years, and this work has been carried on with special reference to their practical value. It has become increasingly evident that life zones furnish a fairly accurate index to average climatic conditions and, therefore, are useful as marking the limits of agricultural possibilities, so far as these are dependent upon climate. The knowledge thus gained has been published and made available as the investigations have progressed and the life zones have been mapped.[1]

The opening up to agriculture of the arid and semiarid West through irrigation and efficient methods of conserving the natural

[1] For detailed discussion and classification of the life zones of North America see Merriam, C. Hart, Life Zones and Crop Zones of the United States (Bull. 10, Biological Survey, U. S. Dept. Agr., 1898); also Bailey, Vernon, Biological Survey of Texas (North Amer. Fauna No. 25, 1905); Fourth Provisional Zone Map of North America, prepared by the Biological Survey, 1910; Cary, Merritt, Biological Survey of Colorado (North Amer. Fauna No. 33, 1911); and Bailey, Vernon, Life Zones and Crop Zones of New Mexico (North Amer. Fauna No. 35, 1913).

rainfall offers a favorable field for the practical application of this knowledge. A wide range of altitude and a correspondingly varied climate and physiography include from two to six of the major life zones in each of the several States, and the zonal boundaries are on the whole well marked by reason of the usually rapid or abrupt changes in elevation. New areas are continually being reclaimed, while in practically all the Western States large districts await future development. This is especially true of the Rocky Mountain States, where general agriculture has been least developed.

In Wyoming, agriculture has made rapid strides during the past few years, but it has not yet advanced much beyond the experimental stage, and the possibilities are somewhat limited by a cool climate due to high average base level. It appears unlikely that crop production will in future greatly exceed the local demand. There are, however, certain restricted areas of low elevation and moderate climate where a variety of crops and some of the hardier fruits have proved decidedly successful. A special value attaches to these low-lying districts inasmuch as they are immediately surrounded or bordered by extensive nonagricultural areas where mining, lumbering, and stock raising are the principal industries. The melting snows of Wyoming mountains furnish an unfailing supply of water for irrigation purposes, and Federal and private irrigation projects have already reclaimed considerable sections. Much valuable agricultural land in the valleys and basins awaits future development. Useless experimentation might be avoided or a more favorable location secured if the prospective as well as the resident agriculturist, and especially the horticulturist, would become familiar with the groups of native species of mammals, birds, reptiles, and plants which have proved to be closely associated with the areas of successful production of particular crops in other parts of the arid West.

Natural history explorations carried on in recent years by the Biological Survey in all the important physiographic areas of Wyoming warrant the present report on the life zones with the accompanying map (Pl. I). Sufficient material has been gathered also for inclusion of notes on the distribution of conspicuous trees and shrubs and for later reports on the mammals and birds of the State.[1]

[1] The present report combines the results of field investigations for the Biological Survey conducted at various times by Dr. C. Hart Merriam, Vernon Bailey, B. H. Dutcher, J. Alden Loring, Edward A. Preble, Alexander Wetmore, H. E. Anthony, Stanley G. Jewett, and D. D. Streeter, jr.; besides those made by the author since 1909 (see map of Wyoming, showing routes of field parties, fig. 1). Lists and other publications bearing on the distribution of the Wyoming fauna and flora, although few in number, have been freely consulted. For identification of many of the plants collected in the survey the author is indebted to Dr. J. N. Rose and Paul C. Standley, of the U. S. National Herbarium, and to F. V. Coville, curator of the National Herbarium, who has named the *Ribes*. The few reptiles and amphibians collected have been identified by Dr Leonhard Stejneger, of the U. S. National Museum.

PHYSIOGRAPHY AND CLIMATE.

In common with other States of the Rocky Mountain region, Wyoming has a varied physiography and climate and great natural resources. The surface features may be classified broadly as mountains, plains, and valleys or basins.

The continental watershed formed by the main chain of the Rockies enters the State through Yellowstone Park near the midwestern boundary of the forested plateau and maintains a general southeasterly trend along the lofty crests of the Absaroka and Wind River Ranges, lowering in the Red Desert region to arid plains and

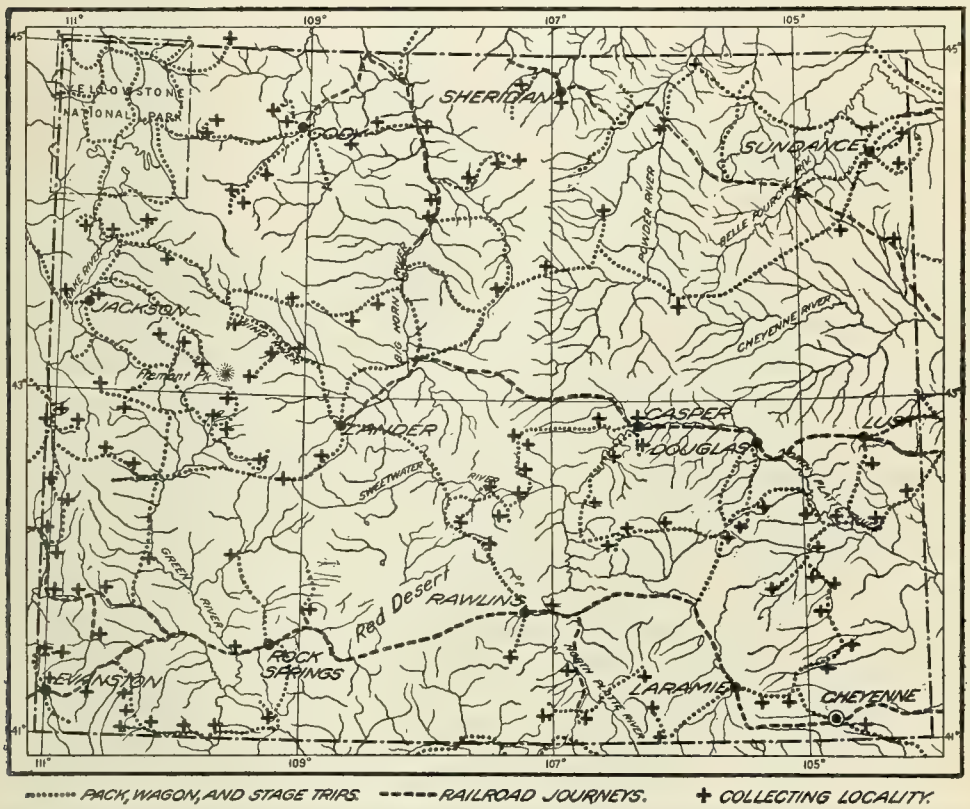


FIG. 1.—Map of Wyoming showing routes and collecting localities of Merritt Cary and other members of the Biological Survey, mainly from 1909 to 1915.

alkaline basins at 7,000 feet elevation, but again rising to the summits of the Sierra Madre, where it crosses the southern boundary of the State near its middle point. This watershed divides the Great Plains from the Great Basin, and on its slopes in northwest Wyoming rise the headwaters of the Colorado in Green River, the Columbia in Snake River, and the Missouri in Yellowstone and Madison Rivers.

The mountains of Wyoming, massed largely in the northwest, occupy approximately a fourth of the total area. Chief among them are the Absaroka, Wind River, Gros Ventre, and Teton Ranges in

the northwest: the Bighorn Mountains in the central northern portion; and the Sierra Madre and the Medicine Bow Ranges at the south. Most of these are heavily forested groups of great elevation, whose summits and crests reach far above timberline and are usually snow capped even in midsummer. All belong to the Rocky Mountain system except the Bighorn Mountains, which alone are detached from the main chain. Gannett Peak in the Wind River Mountains, at 13,785 feet, is the highest point in the State, exceeding the height of its close neighbor, Fremont Peak (13,730 feet); and of the Grand Teton (13,747 feet) in the Teton Range.

The Ferris, Green, Seminole, Shirley, and Rattlesnake Ranges are small separated groups along the upper Platte and Sweetwater Valleys and in the northern borders of the Red Desert, lying a little east of the continental watershed but indicating the general course of the Rockies. These differ greatly in configuration, but are usually characterized by densely forested northern slopes and summits and abrupt barren southern exposures facing the desert. In this region also are the huge bare granite heaps and domes rising from the sandy plain north of the Sweetwater, known collectively as the Granite Mountains. Together, these small ranges are a pleasant relief to a generally barren landscape.

The southwest corner of Wyoming is much broken by the northern timbered shoulders of the Uinta Mountains and by barren elevated ridges and mesas on either side of Green River and east of Bear River. In the southeast the Laramie Mountains are a foothill spur of the Medicine Bows continuous north to the Laramie River Gap and thence in more broken formation extending to the Platte Valley near Casper. Conspicuous groups of outlying hills at the east and northeast are the pine-clad Hartville Mountains north of Guernsey and the densely forested Black Hills and Bear Lodge Mountains.

Although well supplied with mountains, Wyoming is perhaps better known for its vast open plains. These are either level or rolling, lying mainly between 4,500 and 7,000 feet elevation, and are distinguished by characteristic types of vegetation, as the sage plains of the high, arid, interior plateaus; and the grassy plains to the east and northeast, which are part of the Great Plains. These treeless expanses were ranged long before historic times by great bands of buffalo, and, succeeding these, by countless herds of cattle and sheep, and their great grazing value is well attested by the long and bitter warfare for their possession between cattle barons and flockmasters which marked the days of the open range. At present dry farming is greatly restricting the cattle range on the Cheyenne and Lusk Plains and elsewhere along the eastern edge of the State. The extensive arid sage plains farther west, however, are mainly utilized for sheep grazing, to which they are peculiarly adapted.

The numerous valleys of Wyoming are well watered, and with their rich soils and low elevations (chiefly below 5,000 feet) include the areas of greatest agricultural importance and promise. Most important are those of the North Platte, Laramie, Cheyenne, Belle Fourche, Powder, Bighorn, Wind, Sweetwater, and Green Rivers.[1] The Bighorn and Wind River Valleys are extensive basins of low altitude and mild climate, well suited to the production of certain fruits and other crops. The more elevated valleys of the Sweetwater and Green Rivers are mainly devoted to stock raising.

The Red Desert is an extensive barren alkaline plain or basin of great aridity lying mainly west of the continental watershed in the southern part of the State. Without perennial streams and with soils strongly alkaline, it would appear to have no agricultural future. Alkali-resistant desert shrubbery and the moderate winter climate of this region nevertheless combine to furnish an excellent winter range for sheep, and it has long been thus utilized by flock-masters.

Wyoming's lowest elevation is in the extreme northeast, and its highest is in the northwest. Plains and plateaus occupy much of its southern half. The altitudinal extremes are 3,100 feet (approximate), where the Belle Fourche River crosses the eastern boundary; and 13,785 feet, on the summit of Gannett Peak in the Wind River Range.

The climate of the State is mainly arid, the rainfall ranging from 12 to 15 inches in the semiarid eastern Great Plains area to under 10 inches in the extreme arid central desert region (Bighorn Basin[2] and Red Desert). A heavier precipitation in the Bear Lodge and Black Hills districts at the northeast (15 to 20 inches) admits of tolerably successful agriculture without irrigation. The high timbered mountain ranges receive a great deal of moisture, not only as winter snows, but also during summer as frequent heavy, dashing rains.[3]

The elevated base level of Wyoming (about 6,000 feet) insures a generally cool climate. Warm summers (mean summer temperature about 65° F.) with a long growing season and moderate winters with light snowfall are the rule only at the lower levels in the north and east. The high interior valleys, plains, and plateaus are marked by short, cool summers (mean summer temperature about 55° F.), with prevalent late spring frosts, and by long winters with tolerably heavy snowfall and frequent cold winds. The snowfall is excessive in the mountainous country of the northwest, where occasionally very

[1] Most of the valleys are treated in some detail under their respective zones.

[2] The lowest parts of the Bighorn Basin often receive less than 6 inches of annual rainfall.

[3] The precipitation usually given for the mountains is over 18 inches, but data are lacking for the higher altitudes, where it must be much greater.

low temperatures are recorded,[1] but the winter season as a whole is perhaps less severe than on the high wind-swept plains.

For a State with an arid climate Wyoming is exceptionally well watered, and among its natural resources none is more essential to its future development than its rivers and streams. The Snake, Yellowstone, Bighorn, and Green Rivers rise in the mountains of the northwest; the Tongue, Powder, Belle Fourche, and Cheyenne Rivers, with their numerous tributaries, head in the Bighorn Mountains and the elevations of the northeast; while the North Platte and Laramie Rivers, which describe long, circuitous courses in the southeastern part of the State, have their sources in the high ranges of Colorado.

LIFE ZONES OF WYOMING.

Wyoming has a generous representation of animal and plant life. This is largely due to the varied climate resulting from a difference in altitude within its borders of nearly 10,700 feet; and in a lesser degree to a difference in latitude of 4 degrees, and a wide range of local physiographic conditions.

The life zones range from Upper Sonoran (the western arid subdivision of the Upper Austral Zone) at the lowest and warmest elevations, through the Transition, Canadian, and Hudsonian, to the Arctic-Alpine Zone on the crests of the highest mountain ranges. Of the seven North American transcontinental life zones, only the Lower Sonoran and the Tropical are unrepresented; and the Upper Sonoran Zone, while covering large areas, is represented only by its upper, cooler part.

The five zones present in Wyoming are briefly characterized as follows: *Upper Sonoran*, the zone of broad-leaved cottonwood, juniper, saltbush, and yucca, occupying most of the valleys and low plains; *Transition*, the zone of yellow pine, narrow-leaved cottonwood, and pure sagebrush, embracing the high plains, the basal slopes of the mountains, and all except the highest foothills; *Canadian*, the Boreal forest belt of spruce, fir, lodgepole pine, and aspen, covering the middle mountain slopes and highest foothill ranges; *Hudsonian*, the narrow zone or belt of white-barked pine and dwarfed spruce and fir, in the timberline region; and *Arctic-Alpine*, the treeless zone, on mountain crests and peaks above timberline.

Zonal boundaries and sequence usually are well marked on ranges rising abruptly from a low base, as on the western slope of the Bighorn Mountains, where a vertical interval of about 9,500 feet may be traversed in 15 or 20 miles; and on the Wind River Range southwest of Lander. Under gradual change in altitude, however,

[1] —45° F. is sometimes recorded in Jackson Hole, and though data are lacking, still lower temperatures undoubtedly are reached on the high ranges.

as on the open plains, the passage from the Upper Sonoran to the Transition Zone is often scarcely noticeable, and in mapping zones generally the limits in many places must be more or less arbitrarily fixed. In a survey of native mammals, birds, reptiles, and plants made at a given locality, a marked preponderance of characteristic species of a zone decides the zonal position; while a nearly equal representation, or a marked absence, of species peculiar to two adjoining zones is indicative of an intermediate position, or the approximate boundary.

The several zones occupy areas of great irregularity in Wyoming owing to the very broken configuration, and their vertical boundaries are subject also to the usual variation resulting chiefly from differences in latitude, base level, and slope exposure. In general, zone levels are lowest in the north because of lower base and higher latitude, and highest in the south where the base level is more elevated.[1]

UPPER SONORAN ZONE.

The arid subdivision of the Upper Austral Zone, the Upper Sonoran, occupies nearly a third of Wyoming (about 30,000 square miles), and covers all the lower levels. Fully half this area lies below 5,000 feet altitude in the eastern and northern sections, and most of it is well characterized. On the high plains and deserts of the south the Sonoran element is present between 5,500 and 6,500 feet elevation, mainly in dilute form. Low altitude, a warm climate and long growing season, and extensive open, level, or gently rolling areas of rich soils combine to make the Upper Sonoran the chief zone of crop production, dependent as in other sections of the arid West upon careful conservation and distribution of the natural water supply. All areas adapted to any extent to horticulture lie within this zone and, because of its agricultural importance, the limits and characterization are somewhat detailed.[1]

The Upper Sonoran areas of Wyoming are mainly broad extensions of the zone from lower elevations on the south, east, and north. Those entering from the south comprise a narrow strip of desert valley along both sides of Green River north nearly to Labarge; and in the Red Desert a broad region of barren plains and alkaline depressions which reaches eastward to include a small area in the upper Platte Valley both north and south of Fort Steele. The above areas are narrowly connected along Bitter Creek, and more broadly over the Snake River Valley in northwest Colorado, and together they form the northernmost extensions of the important Green River Upper Sonoran area.

[1] For detailed boundaries of the zonal areas of Wyoming see the zone map (frontispiece).

Two large tracts of Upper Sonoran country in the east are part of the Great Plains area. The southernmost of these is approximately bounded on the west by the 5,000 to 6,000 foot basal plains flanking the Laramie and Hartville Mountains, and extends north to the narrow strip of Transition Zone along the northern escarpment of the Lusk Plains. In the North Platte Valley the zone continues narrowly through the canyons above Guernsey, then in greater width to Casper, and in dilute character to the Seminole Mountains and to Splitrock in the Sweetwater Valley. North of the Lusk Plains the Upper Sonoran Zone includes most of the Cheyenne River drainage lying between the pure sage plains of the northern central section and the yellow pine country of the Black Hills. The Belle Fourche Valley in the northeast also carries a narrow Upper Sonoran strip around the northern and western bases of the Bear Lodge Mountains, which widens above Moorcroft and extends nearly to the Pumpkin Buttes.

A broad band of this zone entering the State from the north along the Bighorn River and Clarks Fork covers a large extent of low-altitude country in the arid Bighorn and Wind River Basins below 5,500 or 6,000 feet elevation. These two areas, of which the Bighorn Basin is the larger and agriculturally the more important, are narrowly connected through the canyon south of Thermopolis, but are otherwise separated by the elevated Transition Zone ridge of the Owl Creek Mountains. East of the Bighorn Mountains, the valleys of the Tongue, Powder, Little Powder, and Little Missouri Rivers carry narrow tongues of Upper Sonoran Zone some distance into the State, separated more or less widely by low, open or pine-clad Transition Zone watersheds.

In Wyoming, as in other States traversed by the continental watershed, the Upper Sonoran Zone is best treated under its two main subdivisions, the *Great Plains* and the *Great Basin*.

Great Plains Division—Upper Sonoran Zone.

Great uniformity of surface features and characterization marks the Great Plains area from the Dakotas to Texas and west to the eastern foothills of the Rocky Mountains. It is a vast level or undulating region of abundant grasses and moderate rainfall, entirely open except along streams, which are usually fringed with deciduous trees and shrubbery, and also in the rougher parts near the foothills where

[1] The subdivisions are based upon differences in climate, configuration, and native species, and are not to be confused with the physical Great Plains and Great Basin areas as generally understood and with which they are not coextensive. The imperfect characterization of the Great Basin division in Wyoming, particularly as regards its mammal and bird life, is due to high altitude, and in the Red Desert region in part to the infusion of Great Plains species as a result of the continuity of the Sonoran areas on either slope of the Continental Divide.

junipers and pines often occur in scattered growth. Areas of firm soils alternate with tracts of sandhills or rolling sandy country, and as the foothills are approached there are scattered areas of rough bad lands, the bluffs along streams become rocky, while numerous talus ridges, and clay, chalk, or rock buttes of usually irregular but in some places of strikingly symmetrical outline, stand up from the plain (Pl. II). The important streams of the Great Plains have their sources in the Rocky Mountains and course through valleys usually shallow and often sandy, which show little erosion. This type of country is well marked along the eastern edge of Wyoming as far north as Lusk.

The greatest elevation of the Upper Sonoran Zone is in the south, where on the firm-soil plains of the Cheyenne region it becomes dilute at 5,500 feet elevation, and its upper limits are indicated at approximately 6,000 feet, chiefly by absence of characteristic species. Exact delimitation is difficult on these open grassy plains, which extend on a gradual incline to the 7,000-foot base of the Laramie Mountains. The Cheyenne Plains descend steadily northward to the Platte Valley at a little over 4,000 feet, the surface meanwhile becoming broken and the soil sandy. The Sonoran element is very pronounced in the warm valleys of the Platte drainage, as in the Chugwater Valley below Bordeaux; in the Laramie Valley at Wheatland, Jetsam, and Uva; in Rawhide Valley below Patrick; in Goshen Hole; and along the North Platte below Guernsey; and agriculture under irrigation in these districts is correspondingly successful and varied.

North of the Platte Valley, and jutting squarely against the eastern bases of the Hartville Mountains and the Rawhide Butte, is an extensive grassy plateau with an elevation of from 4,800 to 5,000 feet, extending east into Nebraska and breaking sharply at the north toward the Cheyenne River. Upper Sonoran species predominate up to 5,000 feet, but the region is near the upper edge of the zone, since rocky buttes, ridges, gulches, and cool northern declivities carry a scrubby growth of yellow pine, Rocky Mountain juniper, red currant, mountain mahogany, and other Transition Zone vegetation. This plateau, often known as the Lusk Plains, is characterized mainly by its luxuriant growth of nutritious grasses and has long been noted as choice cattle range. Extensive areas on both the Cheyenne and Lusk Plains are now utilized in dry farming, to which the soil and climate are well adapted.

Characteristic associations of Upper Sonoran species mark the lower portions of the Cheyenne and Lusk Plains and the North Platte Valley. Large groves of broad-leaved cottonwoods (chiefly *Populus occidentalis*) are on the North Platte and Laramie Rivers

and especially on Sibylee Creek, while in addition to cottonwoods the usual fringe along streams consists of willows, box elder, ash,[1] flowering currant, and wolfberry. Common shrubs or shrubby plants on dry flats, in gulches, and on rocky or gravelly slopes are saltbush, rabbit brush, narrow-leaved sagebrush, yucca (Pl. III), bush morning-glory, sand cherry, and skunk bush.

Some of the most conspicuous and characteristic flowering plants are *Eriogonum annuum*, *Rumex venosus*, *Abronia elliptica*, *Argemone intermedia*, *Cleome serrulata*, *Polanisia trachysperma*, *Lupinus plattensis*, *Astragalus crassicarpus* and *A. mollissimus*, *Psoralea* (spp.), *Petalostemon* (spp.), *Linum rigidum*, *Croton texensis*, *Mentzelia decapetala*, *Opuntia polyacantha*, *Mamillaria vivipara* and *M. missouriensis*, *Anogra albicaulis*, *Meriolix serrulata*, *Lithospermum gmelini*, *Lippia cuneifolia*, *Verbena hastata* and *V. bracteosa*, *Physalis lanceolata*, *Solanum rostratum*, *Pentstemon angustifolius*, *Plantago purshi*, *Liatris punctata*, *Grindelia squarrosa*, *Ratibida columnaris*, *Helianthus annuus* and *H. petiolaris*, *Hymenopappus filifolius*, *Carduus plattensis*, and *Lygodesmia rostrata*.

Mammals which especially mark this region as Upper Sonoran are the Kennicott ground squirrel, prairie-dog, Great Plains grasshopper mouse, prairie harvest mouse, Colorado bushy-tailed wood rat, Hayden field mouse, yellow pocket gopher, sage pocket gopher, Wyoming kangaroo rat, Kansas pocket mouse, Bailey cottontail, black-footed ferret, northern plains mole, and California bat.

Characteristic breeding birds of the plains are the mourning dove, burrowing owl, Arkansas kingbird, Bullock oriole, bronzed grackle, lazuli bunting, lark bunting, western grasshopper sparrow, western lark sparrow, white-rumped shrike, yellow warbler, long-tailed chat, western mockingbird, catbird, and brown thrasher.

Reptiles are poorly represented on the plains of eastern Wyoming. The few conspicuous snakes and lizards include the plains rattlesnake, prairie bull snake, hog-nosed snake, blue racer, garter snakes, desert horned lizard, sand swift, scaly lizard, six-lined lizard, and many-lined skink.

The Upper Sonoran area north of the Lusk Plains is open, but much rougher in configuration, and the shrubby type of vegetation becomes increasingly prominent, especially in the valleys below 4,500 feet elevation, where the Sonoran element is strongest. Grass and cactus flats alternate with tracts of sagebrush, rabbit brush, and greasewood over much of the drainage basin of Cheyenne River, and in the low Belle Fourche and Little Missouri Valleys in northeast Wyoming. The watersheds between the valleys are either ranges of rolling grassy hills or abrupt barren ridges of bad lands of about

[1] Uncommon.

B11596

FIG. 1.—CHUGWATER VALLEY BELOW CHUGWATER.

Juniper and mountain mahogany (*Cercocarpus parvifolius*) on bluffs, and box elders in valley.

B11592

FIG. 2.—WESTERN EDGE OF GREAT PLAINS AREA.

Scattered yellow pines and junipers in butte country southwest of Guernsey (4,800 feet).

B11594

FIG. 1.—PLAINS YUCCA (YUCCA GLAUCA) IN FLOWER IN CHUGWATER VALLEY NEAR BORDEAUX, JULY 1, 1909.

B11593

FIG. 2.—NEARER VIEW OF SAME.

5,000 feet elevation. Extensive breaks with more or less yellow pine, juniper, and Transition Zone shrubbery margin the Cheyenne River basin, especially on the south, while the watercourses usually are bordered narrowly with gnarled cottonwoods, willows, box elders, and other deciduous trees and shrubs, as along plains streams generally.

Sagebrush country rapidly takes the place of grassy plains west of Lusk, varied in the upper valley of the Platte with greasewood, rabbit brush, saltbush, and other desert shrubbery, which becomes increasingly common westward. Shrubby Sonoran vegetation fills also most of the narrow extensions of the Yellowstone Valley Upper Sonoran Zone in the valleys of the Little Powder, Powder, and Tongue Rivers east of the Bighorn Mountains.

Although the shrubby type of desert vegetation, more barren surface, and greater aridity of the upper Platte Valley, and the Upper Sonoran areas between the Black Hills and Bighorn Mountains, would seem to place them with the Great Basin division of the zone, their mammals, birds, and herbaceous plants are mainly those of the Great Plains. Species which are absent or rare on the plains farther south include among plants the greasewood, black sagebrush, several species of rabbit brush, white sage, saltbushes, and stanleya; and among mammals, the Maximilian and Sweetwater pocket mice.[1]

Upper Sonoran areas of eastern Wyoming are within the semiarid region and receive in most sections a mean annual rainfall of from 12 to 15 inches. This is sufficient for a luxuriant growth of the best varieties of range grasses in all sections with suitable soils, but will not admit of agriculture apart from irrigation or dry-farming methods, except possibly around the base of the Black Hills, where the precipitation is a little greater. Under irrigation the rich alluvial soils of the valleys yield abundant crops, while the moderate returns from the soil secured most years in the dry-farming communities scattered over the plains are inducing a steadily increasing settlement of these districts.

Great Basin Division—Upper Sonoran Zone.

The Green River Valley, Red Desert, and the Bighorn and Wind River Basins have a barren surface which shows everywhere much erosion, especially along the larger streams, which in many places flow through rugged canyons. These open interior areas of from 4,000 to 6,500 feet elevation lie within the arid region of slight rainfall, and the scanty vegetation is of the shrubby, bunchlike,

[1] A number of mammals and birds and a few plants found commonly on the Lusk Plains and southward do not reach this region.

desert type so characteristic of the Great Basin region as a whole (Pl. IV, fig. 2), in marked contrast with the grassy plains of eastern Wyoming. A narrow fringe of scattering junipers usually marks the upper border of the zone on the rough lower margins of these desert valleys and basins, while considerable areas of junipers with scattering pinyons partly fill the upper part of the zone in lower Green River Valley, and in the extreme southwestern borders of the Red Desert.[1] The Great Basin division is better characterized in Wyoming by vegetation and climate than as a faunal region,[2] although a few Great Basin species of both mammals and breeding birds occur in the Green River Valley and on the Red Desert. The mammals and birds of the Wind River and Bighorn Basins are mainly those common to the Great Plains.

The great dearth of rainfall in these desert areas precludes ordinary agriculture and even dry farming. Effective agriculture is therefore possible through irrigation alone.

Green River Valley—Upper Sonoran Zone.

The Upper Sonoran area extending north along Green River nearly to Labarge is considered apart from the Red Desert, with which it is connected, on account of different topographic features and a stronger characterization in its lower part, near the Utah boundary, where the elevation is only 5,800 feet in the river valley. In this section it is a rough incised region of rocky, juniper-clad ridges and dry, open canyons or narrow valleys reaching gradually down to Green River from high, bordering Transition Zone hills and mesas; and of precipitous, brightly colored canyons whose various shades of red and yellow are in strong contrast with the intense black of the juniper ridges. The steep, hot, protected slopes of this broken canyon region carry the Upper Sonoran Zone regularly as high as 7,000 feet.

Its species are characteristic of the juniper and pinyon belt of the Great Basin, but are in less variety than in this part of the zone farther south, and some of them reach but a short distance into the State. Junipers, scattering pinyons, mountain mahogany, shadscale, syringa, and cactuses comprise the principal vegetation on ridges and dry slopes; saltbushes, grayia, yellow cleome, eriogonum, and cactuses are common shrubs and plants on the open sand or adobe flats in the valleys between the ridges; the skunk bush and flowering currant form characteristic shrubbery on the bluffs immediately along Green River; while extensive flats in the wider parts of the river valley are

[1] The belt of junipers and pinyons, which in regions farther south is usually present in good width and characterizes the upper part of this division of the zone, is but poorly indicated in Wyoming, where the zone is more often open throughout.

[2] See footnote, p. 14.

densely covered with greasewood (Pl. IV, fig. 1) and glasswort in damp, alkaline spots.

The gray titmouse, Baird wren, and pinyon jay are common birds in the juniper growth, and probably breed, as does also the sage sparrow, on the greasewood flats. Among the characteristic Upper Sonoran mammals of this region are the least and rock chipmunks, golden-breasted canyon mouse, True's cliff mouse, Green River pocket gopher, and Great Basin spotted skunk. The reptiles and amphibians include the plains rattlesnake, scaly rock lizard, Stansbury sand lizard, short-horned lizard, and the spadefoot toad.

North of the canyon region, which extends to within 15 or 20 miles of the town of Green River, the Upper Sonoran Zone spreads out in dilute form to include the lower valleys of the Black Fork and Big Sandy, connecting eastward through the Bitter Creek drainage with the larger area on the Red Desert.[1] As a narrowing strip along Green River it continues to the warm valley flats between Fontenelle and Labarge. This is an open, deeply eroded region of barren valleys and bench lands, of bare mesas and variously colored bad lands, buttes, and bluffs, whose zonal position is best defined by its conspicuous vegetation, chiefly that common to the Red Desert. Upper Sonoran species of mammals and breeding birds are comparatively few in number in this high part of the zone, where saltbushes, grayia, small brown sagebrush, rabbit brush, and other desert shrubbery, and such plants as yellow cleome and stanleya give way to the pure sage and rabbit brush plains of the Transition Zone at about 6,500 feet elevation.

The Green River Valley is rather bleak and inhospitable and does not seem to invite agricultural development. In character it resembles the Red Desert in many ways, but is less intensified, particularly in the aridity and the alkalinity of its soils. Owing to erosion, there is little valley land, and this little is partly used in the cultivation of forage crops. At the north a limited agriculture is possible, wherever lands can be brought under irrigation, on the small areas of bench lands which lie along Green River and its few permanent side streams. The rainfall is insufficient for a good growth of forage grasses, yet large numbers of sheep subsist upon the desert shrubbery and scanty grass. Sheep grazing appears to be the most practicable industry, and the rough character of lower Green River Valley, with its many sheltered canyons, warm protected slopes, and mild climate, peculiarly fits it for a winter range.

Red Desert—Upper Sonoran Zone.

Fairly constant surface features obtain over the open elevated region of undulating plains and alkaline depressions or basins, known

[1] See frontispiece (map).

as Red Desert, which is particularly characterized by great aridity, saline or other strongly alkaline soils, and dearth of permanent surface water. The only relief to the general monotony and barrenness is in scattering buttes, occasional ranges of low hills, bluffs along dry washes, or summits of distant bordering hills and mountains. The impression of barrenness is only intensified by the prevalent dull greenish gray or occasional light-gray hues of desert shrubbery.[1] The continental watershed extends across the north-central portion at an elevation of less than 7,000 feet where lowest, being crossed by the Union Pacific Railroad at Creston at 7,000 feet. Eastward the altitude decreases slightly toward the North Platte Valley (6,500 feet), and westward slopes through its only conspicuous drainage area, Bitter Creek Valley, to 6,000 feet on Green River. The climatic features are hot sunny days, cool nights, very slight rainfall during a short summer, and a long, moderately open winter. The heaviest snows are often in spring and are more beneficial to vegetation than summer rains, which are either largely lost through rapid evaporation or, in the case of the occasional heavier showers, quickly run off the barren slopes and fill the dry gulches with muddy torrents. Frosts are not uncommon during the height of the growing season.

Dilute Upper Sonoran Zone, poorly characterized apart from vegetation, covers the lower portion of the Red Desert to 6,500 or 6,800 feet altitude, a total area of between 5,000 and 6,000 square miles, including the North Platte Valley from the Platte Canyon to above Fort Steele. The conspicuous and dominant vegetation is Upper Sonoran desert shrubbery—the various species of saltbush, the white sage, greasewood, grayia, kochia, rabbit brush, the black sagebrush,[2] and low desert sages; with scattering desert junipers on many of the bluffs. A willow (*Salix fluviatilis*) is not uncommon on creeks of the Bitter Creek drainage. Such plants as prickly-pear cactus, yellow cleome, stanleya, many alkali-resistant members of the goosefoot family, and scattering grasses, conspicuous among which are wheat grasses and giant rye-grass, are abundant and characteristic.

The small striped ground squirrel, pocket mice, long-eared bat, least chipmunk, Green River pocket gopher, kangaroo rat, Bailey cottontail, and Great Basin spotted skunk are Upper Sonoran mammals inhabiting the Red Desert.

The variety of bird life is very limited, and few characteristically Sonoran birds breed here. The sage sparrow and western lark sparrow are perhaps most nearly restricted to the zone. Other birds found in abundance during the breeding season, the Brewer spar-

[1] The name "Red Desert," originally applied to a restricted area of reddish soil along the Union Pacific Railroad, does not convey a correct impression of this region as a whole, where desert vegetation instead of soil lends the characteristic colors.

[2] Abundant also in Transition Zone.

row, thick-billed redwing, western meadowlark, western nighthawk, sage thrasher, and white-rumped shrike, breed also on the surrounding sage plains of the Transition Zone.

This arid, barren waste is naturally unsuited to human habitation. Not only do the extensive alkaline deposits in the desert basins tend to make soil conditions over large areas unsuitable for crops, but even the underground water over practically the entire region is strongly alkaline and unfit for use. These conditions, combined with a deficient rainfall and absence of perennial streams, give no promise of an agricultural future. The few ranches are situated mainly along the skirts of the desert, where a number of small creeks coursing down from higher country furnish sufficient water for small fields and garden patches before being lost in the sand. Others are found at the few widely separated springs which rise in different parts of the desert. A ready and remunerative market for garden truck is furnished by the large coal-mining town of Rock Springs, and trucking is carried on in that district wherever there is sufficient water for irrigating a small garden patch.

The chief value of the Red Desert, aside from the extensive coal fields in its western part, is as a winter range for the hundreds of thousands of sheep which spend the summer on the higher plains and in the hills and mountains of central and western Wyoming. The abundant sagebrush, greasewood, and saltbushes, particularly the Nuttall saltbush (see Pl. IV, fig. 2) and other alkali-resistant shrubs and plants, afford an abundance of winter forage,[1] while plenty of water for stock is insured by the snows which drift before the frequent winds and permit browsing in the cleared spaces. Its peculiar adaptation to the winter feeding of sheep, long appreciated by the flockmasters, gives the Red Desert region a special importance as a necessary complement to one of Wyoming's great industries.

Wind River Basin—Upper Sonoran Zone.

The Upper Sonoran area drained by Wind River and its affluents lies mainly between 5,000 and 6,000 feet elevation. It extends from the southern escarpment of the Owl Creek Mountains to the northeastern base of the lofty Wind River Range, and at the east and southeast to the broad tract of high, rolling, sagebrush plains which separate it from the Upper Sonoran areas along the Platte and on the Red Desert. In its surface features, climate, vegetation, and animal life this region is generally similar to the Bighorn Basin, with which it is connected narrowly through the rugged canyon which cleaves the Owl Creek Mountains and carries the waters of the

[1] For a full discussion of the pasture value of the alkaline desert basins see Nelson, The Red Desert of Wyoming and its Forage Resources, Bull. 13, Div. of Agrostology, U. S. Dept. Agr., 1898.

Bighorn. The greater elevation of the Wind River Basin results, however, in a weaker characterization of the zone, while extensive areas of rough bad lands, which fill much of the upper (western) part between Wind River and the Owl Creek Mountains and form in many places the watersheds between streams elsewhere, greatly restrict the agricultural lands and confine them largely to the valleys. Owing to its proximity to the mountain mass of the Wind River Range, the western edge of this area receives more moisture than the central and eastern portions, where the rainfall seldom exceeds 10 inches.

The Upper Sonoran element is most pronounced in the lower valleys below Riverton, and on the plains and bad lands which jut against the southern bases of the Owl Creek Mountains. The vegetation on the sandy plain north of Shoshoni is typical of the lower elevations generally, consisting of saltbush, greasewood, rabbit brush, small brown sagebrush, spiny sagebrush, yucca, and prickly-pear cactus, with skunk bush and juniper on bluffs, and broad-leaved cottonwood, buffaloberry, flowering currant, and wolfberry along streams. Along the eastern base of the Wind River Range and on the barren slopes and gulches of the higher bad lands dilute Upper Sonoran Zone reaches to nearly 6,000 feet altitude, and here, as well as on the southern side of the Owl Creek Mountains, includes the fringe of scattering junipers which is more or less evident on the margins of the open basin. The effect of slope exposure on zone level is especially noticeable on the warm southern slopes of the Owl Creek Mountains, where the zone is carried regularly to 6,500 feet, at least 500 feet higher than on the cooler basal slopes of the Wind River Mountains, on the opposite side of the basin.

The generally weak character of the Upper Sonoran Zone over the Wind River Basin is evident from the paucity of characteristic zone species of mammals and breeding birds, which include, among mammals, the pale chipmunk, Great Plains grasshopper mouse, kangaroo rat, Bailey cottontail, Great Basin spotted skunk, and California bat; and among birds, the mourning dove, burrowing owl, Arkansas kingbird, Bullock oriole, western lark sparrow, white-rumped shrike, and long-tailed chat. The plains rattlesnake and the desert short-horned and scaly rock lizards are the most noticeable reptiles.

Extensive coal and oil fields are among the natural resources of the Wind River Basin. Agriculture is largely supplemental to cattle and sheep raising. Under irrigation the arable valley lands and some of the lower bench lands are producing fine crops of alfalfa and other forage, and also cereals. The growing season is short for tomatoes and tender vegetables, but most kinds do well and are raised extensively near Lander, Fort Washakie, Riverton, and elsewhere. Apple

growing has proved decidedly successful in certain protected valleys at the base of the mountains southwest of Lander, and small fruits are grown on a considerable scale at Lander and elsewhere. With an abundant supply of water in the Wind River Range, the reclamation and productiveness of considerable areas of both bench and valley lands await the construction of additional and especially higher irrigation canals.

Bighorn Basin—Upper Sonoran Zone.

The drainage basin of the Bighorn River is a large open area of 3,500 to 5,500 feet elevation lying between the high Bighorn and Absaroka Ranges in northwestern Wyoming; extending from the open Transition Zone ridge of the Owl Creek Mountains northward beyond the Montana line. It is a warm, protected section of low altitude and extreme aridity, but with an abundance of permanent streams, while the generally barren surface of its valley and low bench lands or scattered tracts of bad lands supports a scanty desert vegetation. The rainfall is often as light as 5 or 6 inches at Basin and Lovell, in the low central and northern sections, and less than 10 inches elsewhere. The Upper Sonoran Zone in this region covers an area of fairly regular outline about 100 miles in length from north to south by 60 miles in breadth, approximately 6,000 square miles. The zone is strongly characterized in the valleys and over the lower portions generally, reaching its upper limits at a little over 5,000 feet on the bordering sage slopes west and south, and eastward at anywhere from 5,500 to 6,000 feet on the abrupt hot slopes along the western bases of the Bighorn Mountains, where it includes an irregular belt of scattered junipers varying from 500 to 1,000 feet in vertical breadth.

The fauna and flora of the Bighorn Basin are derived alike from the Great Basin and Great Plains regions, and include few if any species not common to some of the other Sonoran areas of Wyoming. Over this region the Upper Sonoran Zone is variously characterized as to vegetation by a rank growth of broad-leaved cottonwood, willow, buffaloberry, skunk bush, and flowering currant along most of the streams; greasewood, rabbit brush, and *Suæda* on adobe river flats; saltbushes, rabbit brush, spiny sagebrush, prickly-pear cactus, and such plants as *Cleome lutea*, *Psoralea tenuiflora*, and *Plantago purshi* on firm-soil benches, with *Grayia spinosa*, *Polanisia trachysperma*, *Lupinus pusillus*, yucca, sand dock, and a small yellow-flowered *Malacothrix* added in sandy areas; and by a scattering growth of juniper and skunk bush on bad lands bluffs and on the rough southern and especially eastern margins of the basin. Extensive barren flats midway between Greybull and Cody have an

almost pure growth of prickly-pear cactus, while similar tracts near Frannie are likewise clothed with the Nuttall saltbush.

Representative breeding birds include the mourning dove, burrowing owl, Arkansas kingbird, Bullock oriole, bronzed grackle, western lark sparrow, sage sparrow, house finch, lazuli bunting, white-rumped shrike, yellow warbler, western yellow-throat, long-tailed chat, catbird, brown thrasher, and western marsh wren.

A few characteristic mammals of the Bighorn Basin are the pale chipmunk, black-tailed prairie-dog, Great Plains grasshopper mouse, Hayden field mouse, sage pocket gopher, kangaroo rat, Maximilian pocket mouse, Bailey cottontail, and the brown and California bats. Several reptiles, the prairie bull snake, plains rattlesnake, horned lizard, and scaly rock lizard, are common over much of the region.

This huge depression between lofty mountain ranges is a highly favored region of great promise. While physically and climatically the best suited to general agriculture of any of the low-altitude areas of western Wyoming, it is, perhaps, best known for its adaptation to horticulture and for the rapid strides already made in the successful production of high-grade apples and other fruits. The warm, sheltered valleys and hot Upper Sonoran slopes along the western bases of the Bighorn Mountains, especially toward the northern end of the basin, are highly favorable to fruit culture. It is in these situations that the older bearing orchards are chiefly located and the best results have thus far been obtained. Young orchards are now extensively planted throughout the lower open portions of the basin and, although more exposed than nearer the mountains, nevertheless give promise of handsome returns under proper care and due attention to local conditions.

The Bighorn River and its principal tributaries, the Shoshone and Greybull Rivers, and Shell, No Wood, and Owl Creeks, fed by the melting snows of high mountain ranges, carry an abundance of water, amply sufficient under proper storage control for watering all irrigable lands in their drainages (fig. 2). Private irrigation projects have already reclaimed considerable portions of the broad and fertile stream valleys, together with the lowest of the adjoining bench lands, and the Federal Shoshone project has opened large tracts in Shoshone Valley. The higher bench lands, at present utilized in sheep grazing, await the construction of more storage dams and higher irrigation canals before they can be made productive.

Characteristic Species—Upper Sonoran Zone.

The delimitation of life zones is based upon the combined ranges of characteristic species of mammals, breeding birds, reptiles, and

B13688

FIG. 1.—BLUFFS ALONG GREEN RIVER NEAR UTAH BOUNDARY.

Dense growth of greasewood (*Sarcobatus vermiculatus*) at left.

B11685

FIG. 2.—DESERT VEGETATION, RED DESERT, SOUTH OF THE FERRIS MOUNTAINS.

Chiefly saltbush (*Atriplex nuttalli*).

B11621

FIG. 1.—YELLOW PINE FOREST NEAR SPRINGHILL, NORTHERN BASE OF LARAMIE PEAK (6,500 FEET).

B11686

FIG. 2.—SAGEBRUSH PLAIN NEAR FORT WASHAKIE, WIND RIVER BASIN.

plants.[1] Species which in Wyoming best mark the Upper Sonoran Zone throughout,[2] or in restricted areas of its Great Plains or Great

B11721

FIG. 2.—Irrigation canal traversing original sage plain on bench north of Burlington, in the Bighorn Basin.

Basin subdivisions, are included in the following lists. Many species of wide zonal dispersion occur commonly in the Upper Sonoran Zone in Wyoming, but as these give no definition to the zone they are not listed.

MAMMALS—UPPER SONORAN ZONE.

[Species marked *T.* occur also in the Transition Zone.]

Antilocapra americana americana, Antelope. *T.*

Eutamias pallidus pallidus, Pale Chipmunk. *T.*

Eutamias minimus minimus, Least Chipmunk.

Eutamias minimus pictus, Sagebrush Chipmunk.

Eutamias dorsalis utahensis, Utah Rock Chipmunk.

Callospermophilus lateralis wortmani, Wortman Mantled Ground Squirrel. *T.*

Citellus obsoletus, Kennicott Ground Squirrel.

Citellus tridecemlineatus pallidus, Pale Striped Ground Squirrel.

Citellus tridecemlineatus parvus, Small Striped Ground Squirrel.

Cynomys ludovicianus ludovicianus, Black-tailed Prairie-dog.

Onychomys leucogaster arcticeps, Great Plains Grasshopper Mouse.

Peromyscus maniculatus osgoodi, Black-eared White-footed Mouse. *T.*

Peromyscus maniculatus nebrascensis, Yellow White-footed Mouse.

Peromyscus crinitus auripectus, Golden-breasted Canyon Mouse.

Peromyscus truei truei, True's Cliff Mouse.

Reithrodontomys megalotis dychei, Prairie Harvest Mouse.

[1] Species of insects and other groups might be equally useful in the determination of zones if their ranges were better known.

[2] See frontispiece (map).

MAMMALS—UPPER SONORAN ZONE—Continued.

Neotoma cinerea orolestes, Colorado Bushy-tailed Wood Rat. *T.*

Microtus ochrogaster haydeni, Hayden Field Mouse.

Fiber zibethicus cinnamominus, Great Plains Muskrat. *T.*

Geomys lutescens, Yellow Pocket Gopher.

Thomomys ocius, Green River Pocket Gopher.

Thomomys talpoides bullatus, Sage Pocket Gopher.

Perodipus ordii luteolus, Wyoming Kangaroo Rat.

Perognathus hispidus paradoxus, Kansas Pocket Mouse.

Perognathus fasciatus fasciatus, Maximilian Pocket Mouse. *T.*

Perognathus fasciatus litus, Sweetwater Pocket Mouse.

Perognathus flavus pipcri, Cheyenne Pocket Mouse.

Perognathus callistus, Red Desert Pocket Mouse.

Lepus californicus melanotis, Black-tailed Jack Rabbit.

Sylvilagus auduboni baileyi, Bailey Cottontail.

Sylvilagus floridanus similis, Nebraska Cottontail.

Canis nebracensis, Plains Coyote. *T.*

Vulpes velox velox, Kit Fox, Swift. *T.*

Procyon lotor lotor, Raccoon. *T.*

Taxidea taxus taxus, Badger. *T.*

Spilogale gracilis saxatilis, Great Basin Spotted Skunk.

Mustela nigripes, Black-footed Ferret.

Scalopus aquaticus caryi, Northern Plains Mole.

Myotis californicus californicus, California Bat.

Myotis evotis, Long-eared Bat.

Myotis longicrus interior, Long-legged Bat. *T.*

Eptesicus fuscus fuscus, Brown Bat. *T.*

BREEDING BIRDS—UPPER SONORAN ZONE.

[Species marked *T.* breed also in the Transition Zone.]

Querquedula discors, Blue-winged Teal. *T.*

Querquedula cyanoptera, Cinnamon Teal. *T.*

Botaurus lentiginosus, Bittern. *T.*

Ardea herodias, Great Blue Heron. *T.*

Nycticorax nycticorax nævius, Black-crowned Night Heron. *T.*

Rallus virginianus, Virginia Rail.[1]

Porzana carolina, Carolina Rail, Sora. *T.*

Fulica americana, Coot. *T.*

Bartramia longicauda, Upland Plover. *T.*

Numenius americanus, Long-billed Curlew. *T.*

Zenaidura macroura carolinensis, Mourning Dove.

Archibuteo ferrugineus, Ferruginous Rough-legged Hawk. *T.*

Spcotyto cunicularia hypugæa, Burrowing Owl.

Chordeiles virginianus henryi, Western Nighthawk. *T.*

Tyrannus tyrannus, Kingbird. *T.*

Tyrannus verticalis, Arkansas Kingbird.

Tyrannus vociferans, Cassin Kingbird.

Corvus brachyrhynchos hesperis, Western Crow. *T.*

Cyanocephalus cyanocephalus, Pinyon Jay.

Xanthocephalus xanthocephalus, Yellow-headed Blackbird. *T.*

Agelaius phœniceus fortis, Thick-billed Redwing. *T.*

Sturnella neglecta, Western Meadowlark. *T.*

Icterus bullocki, Bullock Oriole.

Quiscalus quiscula æneus, Bronzed Grackle.

Carpodacus mexicanus frontalis, House Finch.

Ammodramus savannarum bimaculatus, Western Grasshopper Sparrow.

Chondestes grammacus strigatus, Western Lark Sparrow.

Spizella breweri, Brewer Sparrow. *T.*

[1] Observed during breeding season.

BREEDING BIRDS—UPPER SONORAN ZONE—Continued.

Amphispiza nevadensis, Sage Sparrow.
Passerina amœna, Lazuli Bunting.
Spiza americana, Dickcissel.
Calamospiza melanocorys, Lark Bunting. *T.*
Lanius ludovicianus excubitorides, White-rumped Shrike. *T.*
Dendroica æstiva æstiva, Yellow Warbler. *T.*
Geothlypis trichas occidentalis, Western Yellow-throat. *T.*
Icteria virens longicauda, Long-tailed Chat.
Oreoscoptes montanus, Sage Thrasher. *T.*
Mimus polyglottos leucopterus, Western Mockingbird.
Dumetella carolinensis, Catbird.
Toxostoma rufum, Brown Thrasher.
Thryomanes bewicki bairdi, Baird Wren.[1]
Telmatodytes palustris plesius, Western Marsh Wren.
Bœolophus inornatus griseus, Gray Titmouse.[1]
Psaltriparus plumbeus, Lead-colored Bush-tit.[1]
Polioptila cærulea obscura, Western Gnatcatcher.[1]

REPTILES—UPPER SONORAN ZONE.

[Species marked *T.* occur also in the Transition Zone.]

Lizards.

Holbrookia maculata, Sand Swift.
Uta stansburiana, Stansbury Lizard.
Sceloporus consobrinus, Scaly Lizard.
Sceloporus graciosus, Scaly Rock Lizard.
Phrynosoma ornatissimum, Desert Short-horned Lizard. *T.*
Cnemidophorus sexlineatus, Six-lined Lizard.
Eumeces multivirgatus, Many-lined Skink.

Snakes.

Thamnophis sirtalis parietalis, Red-barred Garter Snake. *T.*
Thamnophis radix, Garter Snake. *T.*
Bascanion constrictor, Blue Racer.
Pituophis sayi, Prairie Bull Snake.
Liopeltis vernalis, Smooth Green Snake. *T.*
Heterodon nasicus, Hog-nosed Snake.
Crotalus confluentus, Plains Rattlesnake.

AMPHIBIANS—UPPER SONORAN ZONE.

[Species marked *T.* occur also in the Transition Zone.]

Toads and frogs.

Scaphiopus hammondi bombifrons, Spadefoot Toad.
Bufo lentiginosus woodhousei, Toad. *T.*
Bufo cognatus, Toad.
Rana pipiens, Leopard Frog. *T.*

Salamanders.

Ambystoma tigrinum, Tiger Salamander. *T.*

[1] Probably breeds.

Plants Upper Sonoran Zone.

[Species marked *T.* occur also in the Transition Zone.]

Trees and shrubs.

Pinus edulis, Pinyon, Nut Pine.
Juniperus knightii, Desert Juniper.
Juniperus monosperma, One-seeded Juniper.
Populus occidentalis, Broad-leaved Cottonwood.
Populus acuminata, Lance-leaved Cottonwood.
Salix amygdaloides, Peach-leaved Willow.
Salix fluviatilis, Sand-bar Willow.
Ulmus americana,[1] Elm. *T.*
Acer negundo, Box Elder. *T.*
Fraxinus lanceolata, Ash. *T.*
Cercocarpus parrifolius, Mountain Mahogany. *T.*
Sarcobatus vermiculatus, Greasewood.
Atriplex canescens, Saltbush, Gray Shadscale.
Atriplex confertifolia, Spiny Saltbush.
Atriplex nuttalli, Nuttall Saltbush.
Atriplex pabularis, Nelson Saltbush.
Atriplex argentea, Silvery Saltbush.
Eurotia lanata, White Sage, Winter Fat.
Grayia spinosa, Grayia.
Kochia americana, Kochia, White Sage.
Philadelphus occidentalis, Western Syringa.
Ribes longiflorum, Flowering Currant.
Prunus americana, Wild Plum. *T.*
Prunus besseyi, Sand Cherry.
Amorpha canescens, False Indigo, Shoestring. *T.*
Amorpha nana, False Indigo.
Schmaltzia trilobata, Skunk Bush.
Schmaltzia glabra, Smooth Sumac. *T.*
Rhus rydbergi, Western Poison Ivy. *T.*
Vitis vulpina, Wild Grape. *T.*
Parthenocissus vitacea, Virginia Creeper. *T.*
Lepargyrea argentea, Buffaloberry. *T.*
Symphoricarpos occidentalis, Wolfberry. *T.*
Gutierrezia sarothræ, Rabbit Brush.
Chrysothamnus graveolens, Rabbit Brush.
Chrysothamnus plattensis, Rabbit Brush.
Chrysothamnus linifolius, Rabbit Brush.
Chrysothamnus stenophyllus, Rabbit Brush.
Tetradymia inermis, Rabbit Brush.
Tetradymia spinosa, Rabbit Brush.
Tetradymia nuttalli, Rabbit Brush.
Artemisia filifolia, Narrow-leaved Sagebrush.
Artemisia spinescens, Spiny Sagebrush, Budbrush.
Artemisia pedatifida, Small Brown Sagebrush.
Artemisia tridentata, Black Sagebrush. *T.*

Herbaceous plants.

Tradescantia occidentalis, Spiderwort.
Yucca glauca, Plains Yucca.
Eriogonum effusum, Eriogonum.
Eriogonum annuum, Eriogonum.
Eriogonum campanulatum, Eriogonum.
Eriogonum corymbosum, Eriogonum.
Eriogonum multiceps, Eriogonum.
Rumex venosus, Sand Dock.
Suæda diffusa, Sea Blite.
Suæda moquini, Shrubby Blite.
Endolepsis suckleyana.
Salicornia rubra, Glasswort. *T.*
Abronia fragrans.
Abronia elliptica.
Argemone intermedia, Prickly Poppy.
Argemone hispida, Prickly Poppy.
Stanleya tomentosa, Stanleya.
Stanleya integrifolia, Stanleya.
Cleome lutea, Yellow Cleome.
Cleome serrulata, Red Cleome, Honey Plant.
Polanisia trachysperma, Clammy-weed.
Lupinus plattensis, Lupine.
Lupinus pusillus, Small Lupine.

[1] Northeast Wyoming only.

PLANTS—UPPER SONORAN ZONE—Continued.

Herbaceous plants—Continued.

Astragalus crassicarpus, Buffalo Bean, Ground Plum.
Astragalus mollissimus, Milk Vetch.
Astragalus missouriensis, Milk Vetch.
Glycyrrhiza lepidota, Wild Licorice. *T.*
Psoralea tenuiflora, Psoralea.
Psoralea linearifolia, Narrow-leaved Psoralea.
Psoralea lanceolata, Psoralea.
Psoralea hypogea, Psoralea.
Psoralea esculenta, Psoralea.
Parosela enneandra, Dalea.
Petalostemon oligophyllus, White Prairie Clover.
Petalostemon candidus, Prairie Clover.
Petalostemon purpureus, Purple Prairie Clover.
Petalostemon villosus, Silky Prairie Clover.
Lathyrus ornatus, Wild Pea, Vetchling.
Linum rigidum, Wild Flax.
Euphorbia marginata, Snow-on-the-mountain.
Croton texensis, Croton.
Malvastrum coccineum, False Mallow.
Malvastrum dissectum, False Mallow.
Mentzelia decapetala, Loasa.
Mentzelia nuda, Loasa.
Mentzelia albicaulis, Loasa.
Mentzelia lævicaulis. Yellow Loasa. *T.*
Mamillaria missouriensis, Ball Cactus. *T.*
Mamillaria vivipara, Ball Cactus.
Echinocereus viridiflorus, Green-flowered Petaya. *T.*
Opuntia polyacantha, Prickly Pear.
Opuntia rutila, Prickly Pear.
Anogra albicaulis, White Evening Primrose.
Galpinsia lavandulæfolia.
Meriolix serrulata.
Gaura coccinea.
Asclepias speciosa, Milkweed.
Asclepias pumila, Milkweed.
Ipomœa leptophylla, Bush Morning-glory.
Gilia polycladon.
Lithospermum angustifolium, Gromwell. *T.*
Lithospermum gmelini, Gromwell.
Oreocarya flava.
Lippia cuneifolia.
Verbena hastata, Blue Vervain.
Verbena bracteosa, Low Vervain.
Physalis lanceolata, Ground Cherry.
Solanum rostratum, Buffalo Bur.
Pentstemon albidus, Beard-tongue.
Pentstemon angustifolius, Beard-tongue.
Plantago purshi, Plantain.
Liatris punctata, Blazing Star.
Grindelia squarrosa, Gum Plant.
Sideranthus spinulosus.
Solidago mollis, Goldenrod.
Solidago canadensis gilvocanescens, Goldenrod.
Solidago rigida, Goldenrod.
Ratibida columnaris, Cone Flower.
Helianthus annuus, Sunflower.
Helianthus petiolaris, Sunflower.
Hymenopappus filifolius.
Carduus plattensis, Thistle.
Malacothrix sonchoides.
Lygodesmia juncea.
Lygodesmia rostrata.

Grasses.

Andropogon scoparius, Bluestem.
Andropogon halli, Bluestem.
Panicum virgatum, Panic Grass.
Aristida longiseta, Wire Grass. *T.*
Stipa comata, Feather Grass.
Stipa viridula, Feather Grass. *T.*
Oryzopsis micrantha, Rice Grass.
Eriocoma cuspidata, Indian Millet.
Muhlenbergia pungens, Dropseed Grass.
Sporobolus airoides, Fine-top Salt Grass.
Sporobolus cryptandrus, Bunch Grass.
Calamovilfa longifolia, Reed Grass, Sand Grass.
Schedonnardus paniculatus, Crab Grass.

PLANTS—UPPER SONORAN ZONE—Continued.

Grasses—Continued.

Spartina gracilis, Marsh Grass.
Boutcloua oligostachya, Grama Grass. *T.*
Boutcloua hirsuta, Grama Grass.
Atheropogon curtipendula, Tall Grama. *T.*
Bulbilis dactyloides, Buffalo Grass.
Munroa squarrosa, False Buffalo Grass.
Eatonia obtusata.
Distichlis spicata, Salt Grass.
Poa fendleriana, Spear Grass. *T.*
Poa sheldoni, Spear Grass. *T.*
Festuca octoflora, Fescue Grass.
Agropyron spicatum, Wheat Grass.
Agropyron smithi, Wheat Grass. *T.*
Sitanion longifolium, Long-bearded Rye Grass. *T.*
Sitanion hystrix. *T.*
Elymus canadensis, Wild Rye. *T.*
Elymus condensatus, Giant Rye Grass. *T.*
Elymus salinus, Desert Rye Grass.

Agricultural Utility of the Upper Sonoran Zone.

The growing of hay and forage crops as supplemental to stock raising and a limited planting of cereals and vegetables for ranch use long constituted the chief agricultural endeavors in even the most favored sections of Wyoming. The establishment of agriculture as a separate industry in this arid region is comparatively recent, the result of greatly increased irrigation facilities and of more efficient methods of conserving the rainfall in the less arid dry-farming districts.

The Upper Sonoran areas of Wyoming lie mainly in the upper and cooler parts of the zone and are therefore climatically unsuited to a variety of tender crops, and especially fruits, which are successfully grown elsewhere in its lower and warmer portions. They are proving well adapted, however, to most of the standard varieties of wheat, oats, rye, emmer, and other cereals, which yield abundantly under irrigation and moderately under dry farming. None but the early varieties of corn mature, and these are raised to a small extent only in the warmest parts, as in the lower Platte and Bighorn Valleys. Alfalfa, the staple forage crop, produces regularly two and at the lowest elevations often three or even four crops a year. Sugar beets are raised extensively in the Bighorn Basin, the lower Platte Valley, and near Wheatland. The sugar content of Wyoming beets is high, and with the construction of local sugar factories this crop should become one of the most important and profitable. Potatoes yield abundantly and are well adapted to the dry-farming districts along the eastern edge of the State, where they are produced on a large scale. Vegetables of most sorts thrive under irrigation, and trucking is profitably carried on in many valleys. The tender sorts usually succeed in the warmest localities, but can not be raised generally, because of the short growing season.

Fruit growing has been attempted on a commercial scale mainly in the Bighorn Basin, near Lander, and in the Wheatland district, where many of the hardier varieties of apples, cherries, and plums, as well as the small fruits, raspberries, strawberries, grapes, currants, gooseberries, and dewberries, are moderately successful under irrigation. Even in these sheltered and favored districts the physical and climatic conditions are so localized that successful horticulture will perforce be limited to comparatively small areas where there is ample protection and the greatest freedom from the destructive late frosts, which kill so much of the fruit blossom in this zone throughout the Rocky Mountain region. Late-flowering and frost-resistant varieties succeed best.

TRANSITION ZONE.

Fully half of Wyoming, or about 50,000 square miles, is in the Transition Zone, the zone intermediate between the Boreal and Austral regions, which is here in its greater part open and treeless, and thus less conspicuously characterized than in the southern Rocky Mountain region, where it is very generally marked by extensive forests of yellow pine. In Wyoming the zone comprises, broadly, vast interior sagebrush plains (see Pl. V, fig. 2) and watersheds, plateaus, and high-altitude basins in the central and southwest sections; and elevated grassy plains to the east and southeast. It also includes all except the higher summits of the pine-clad foothill ranges in the eastern part of the State, and the open basal sagebrush slopes of the high mountain ranges farther west. In greater detail,[1] the Transition Zone in Wyoming embraces the following important areas:

The Cheyenne Plains above 5,500 feet elevation; Lusk Plains above 5,000 feet; all of the Laramie Plains and Shirley Basin; upper valley of the North Platte above 6,500 feet; upper Green River Basin, Bear River region, and extensive tracts on the borders of the Red Desert above 6,500 feet; sage plains between Casper and Lander above 6,000 feet; Wind River Valley above 6,000 feet; mainly open borders of the Bighorn Basin, 5,500 to 7,000 or 7,500 feet; all open or partly timbered watersheds between the Bighorn and Bear Lodge Mountains above 4,500 feet; basal and middle slopes of Bear Lodge Mountains and northern Black Hills, 4,000 to 5,500 feet; and southern Black Hills region, 4,500 to 6,000 feet. Limited areas in Jackson Hole and Salt River Valley are eastward continuations of the Snake River Transition Zone, and narrow strips of the zone enter Yellowstone Park for a short distance along the Yellowstone,

[1] See zone map (frontispiece).

penetrating the valleys of the Gardiner, Lamar, and other tributaries, and also along the Gallatin, Madison, and Fall River valleys.

The foregoing well illustrates the effect of both base level and latitude on the vertical position of the Transition Zone. A base level of over 6,000 feet in the southwest elevates the zone in all of the region contiguous to the Red Desert and Green River Valley to between 7,000 and 8,500 feet on warmest (southwest) slopes and 6,000 to 7,500 feet on coldest (northeast) slopes. In extreme northeastern Wyoming, adjacent to the low-altitude northern Great Plains, the zone level attains only 4,500 to 6,000 feet on southwest slopes and 4,000 to 5,500 feet on northeast slopes.[1] Much of this 2,000-foot variation in zone level results from difference in base elevation, while probably 800 feet is normal depression in the northeast due to higher latitude. Locally, mountain slopes of unusual exposure and warmth carry zones abnormally high, and if very steep and abrupt the horizontal contraction is also very marked. This is well shown in the Transition belt on the abrupt, hot, southwest slopes of the Bighorn Mountains east of Greybull and Ionia. Varied physical conditions, and, to a certain extent, deforestation, affect both the elevation and the horizontal as well as the vertical width of life zones, especially in mountainous districts. In the main, however, the Transition Zone is maintained in fairly uniform elevation and width along the bases of the Wyoming ranges.

Characteristic Species—Transition Zone.

The Transition Zone in Wyoming is conspicuously marked only along its upper border, where mostly open sage slopes give way to the aspen and coniferous forest belt of the Canadian Zone. Inconspicuous vegetation is characteristic of the lower part on the open plains, where the zonal position is further indicated by either the absence or a marked paucity of Sonoran species. As elsewhere in the Rocky Mountain region, its fauna and flora are fairly constant throughout, but include many species, both Boreal and Austral, from the adjoining zones.

Sagebrush, yellow pine, and grasses are prominent types of vegetation in the Wyoming Transition area. The sagebrush (Pl. VI), the most widely distributed shrub, usually occurs in pure growth, while the yellow pines are restricted largely to the lower mountains, foothills, and rough tracts in the eastern half of the State. Considerable Douglas spruce and scattering Rocky Mountain white pines

[1] On exposed slopes of mountains the difference in zone level on the warm and cold sides is usually as much as 1,000 feet. So much variation is not found in the low hill country of northeastern Wyoming.

B11701

FIG. 1.—SAGEBRUSH IN WIND RIVER VALLEY.

Lower part of Transition Zone, near Circle.

B11650

FIG. 2.—GARFIELD PEAK, RATTLESNAKE MOUNTAINS.

Sagebrush covers much of this barren 8,000 to 9,000 foot range.

B11619

FIG. 1.—RAWHIDE BUTTE, LOWER BORDER OF TRANSITION ZONE, AT EDGE OF GREAT PLAINS.

Narrow-leaved cottonwoods on Rawhide Creek, southern base of the butte, and yellow pines on hills (5,000 feet).

B13066

FIG. 2.—SOUTHWESTERN BASE OF WIND RIVER RANGE NEAR BIG SANDY.

Rabbit brush (*Chrysothamnus* and *Tetradymia inermis*) on the plain (7,500 feet).

occur in this zone in the mountains of western Wyoming, and the bur oak is a common tree on the Bear Lodge Mountains and elsewhere in northern Crook County. On streams along the bases of the mountains generally the zone is marked by narrow-leaved cottonwood (Pl. VII, fig. 1), diamond willow, and usually by a dense shrubbery of Rocky Mountain birch, black and red haws, cornel, wild gooseberry and currant, serviceberry, and silverberry; on foothill and lower mountain slopes both in the forest as undershrubs and in the open, by Rocky Mountain and creeping junipers, Bebb willow, barberry, wild red currant, mountain mahogany, kunzia, ninebark, wild cherry, mountain and large-toothed maples, mountain balm, bearberry, mountain snowberry, and several high plains species of sagebrush and rabbit brush (Pl. VII, fig. 2); and throughout by a great many herbaceous plants.

A considerable number of birds of both general and restricted breeding range within the zone characterize this area in Wyoming during the nesting season. Representative species are the sage hen, sharp-shinned hawk, saw-whet owl, Lewis woodpecker, white-throated swift, Wright flycatcher, magpie, pinyon jay, McCown longspur, white-winged junco, mountain song sparrow, arctic and green-tailed towhees, western tanager, plumbeous vireo, Macgillivray warbler, Rocky Mountain and pygmy nuthatches, and willow thrush.

Mammals wholly or chiefly restricted to the Transition Zone in different parts of Wyoming include the plains white-tailed deer; Black Hills red squirrel; Wyoming and Uinta ground squirrels; white-tailed prairie-dog; bushy-tailed wood rat; pygmy and Uinta field mice; Coues, Black Hills, Fort Bridger, and pygmy pocket gophers; Uinta pocket mouse; prairie jumping mouse; white-tailed jack rabbit; Black Hills cottontail; northern plains skunk; and long-legged bat.

The following reptiles and amphibians are apparently more abundant in the Transition than in the Upper Sonoran Zone in Wyoming: Western garter snake (*Thamnophis ordinoides vagrans*), a toad (*Bufo boreas*), and a frog (*Rana pretiosus*). Others of regular occurrence in at least the lower part of the zone include the horned lizard (*Phrynosoma ornatissimum*), scaly rock lizard (*Sceloporus graciosus*), garter snakes (*Thamnophis sirtalis parietalis* and *T. radix*), smooth green snake (*Liopeltis vernalis*), western toad (*Bufo lentiginosus woodhousei*), frogs (*Rana pipiens* and *Chorophilus triseriatus*), and tiger salamander (*Ambystoma tigrinum*).

Mammals—Transition Zone.

[Species marked *U.* occur also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Cervus canadensis canadensis, Elk. *C.*
Odocoileus virginianus macrourus, Plains White-tailed Deer.
Odocoileus hemionus hemionus, Mule Deer. *U.*, *C.*
Ovis canadensis auduboni, Bad Lands Sheep.[1] *U.*
Sciurus hudsonicus dakotensis, Black Hills Red Squirrel.
Glaucomys sabrinus canescens, Flying Squirrel.
Callospermophilus lateralis lateralis, Say Ground Squirrel. *C.*
Callospermophilus lateralis wortmani, Wortman Ground Squirrel. *U.*
Citellus richardsoni elegans, Wyoming Ground Squirrel. *U.*
Citellus armatus, Uinta Ground Squirrel. *C.*
Cynomys leucurus, White-tailed Prairie-dog. *U.*
Onychomys leucogaster brevicaudus, Idaho Grasshopper Mouse. *U.*
Onychomys leucogaster missouriensis, Northern Grasshopper Mouse. *U.*
Peromyscus leucopus aridulus, White-footed Mouse.
Neotoma cinerea cinerea, Bushy-tailed Wood Rat.
Neotoma cinerea orolestes, Colorado Bushy-tailed Wood Rat. *U.*
Microtus pennsylvanicus modestus, Saguache Meadow Mouse. *U.*
Microtus montanus caryi, Uinta Meadow Mouse.
Microtus pauperrimus, Pygmy Field Mouse.
Fiber zibethicus osoyoosensis, Rocky Mountain Muskrat. *C.*
Castor canadensis, Beaver. *C.*
Thomomys talpoides nebulosus, Black Hills Pocket Gopher. *C.*
Thomomys talpoides clusius, Coues Pocket Gopher.
Thomomys bridgeri, Fort Bridger Pocket Gopher.
Thomomys pygmæus, Pygmy Pocket Gopher.
Perognathus parvus clarus, Uinta Pocket Mouse.
Zapus hudsonius campestris, Prairie Jumping Mouse.
Erethizon epixanthum, Yellow-haired Porcupine. *C.*
Lepus townsendi campanius, White-tailed Jack Rabbit.
Lepus townsendi townsendi, Western White-tailed Jack Rabbit.
Sylvilagus nuttalli grangeri, Black Hills Cottontail.
Felis hippolestes, Mountain Lion. *C.*
Lynx uinta, Mountain Wildcat.
Canis nubilus, Buffalo Wolf. *U.*
Canis lestes, Mountain Coyote.
Taxidea taxus taxus, Badger. *U.*
Spilogale tenuis, Rocky Mountain Spotted Skunk.
Mephitis hudsonica, Northern Plains Skunk.
Mustela arizonensis, Arizona Weasel. *C.*
Mustela vison energumenos, Mink. *C.*
Ursus horribilis, Grizzly Bear.
Corynorhinus macrotis pallescens, Big-eared Bat. *U.*
Myotis longicrus interior, Long-legged Bat. *U.*

Breeding Birds—Transition Zone.

[Species marked *U.* breed also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Colymbus nigricollis californicus, American Eared Grebe. *U.*
Anas platyrynchos, Mallard. *U.*
Chaulelasmus streperus, Gadwall. *U.*
Nettion carolinense, Green-winged Teal.
Steganopus tricolor, Wilson Phalarope. *U.*
Recurvirostra americana, Avocet. *U.*
Gallinago delicata, Wilson Snipe. *C.*
Catoptrophorus semipalmatus inornatus, Western Willet.

[1] Apparently nearing extinction.

BREEDING BIRDS—TRANSITION ZONE—Continued.

Podasocys montanus, Mountain Plover. *U.*
Pediœcetes phasianellus columbianus, Columbian Sharp-tailed Grouse.
Centrocercus urophasianus, Sage Hen.
Accipiter velox, Sharp-shinned Hawk. *C.*
Accipiter cooperi, Cooper Hawk.
Buteo swainsoni, Swainson Hawk.
Cryptoglaux acadica, Saw-whet Owl.
Otus asio maxwelliæ, Rocky Mountain Screech Owl. *U.*
Asio wilsonianus, Long-eared Owl.
Coccyzus erythropthalmus, Black-billed Cuckoo. *U.*[1]
Dryobates villosus monticola, Rocky Mountain Hairy Woodpecker. *C.*
Dryobates pubescens homorus, Batchelder Woodpecker.
Melanerpes erythrocephalus, Red-headed Woodpecker. *U.*
Asyndesmus lewisi, Lewis Woodpecker.
Phalænoptilus nuttalli nuttalli, Poorwill. *U.*
Aëronautes melanoleucus, White-throated Swift. *U.*
Stellula calliope, Calliope Hummingbird.[2]
Sayornis sayus, Say Phœbe. *U.*
Myiochanes richardsoni, Western Wood Pewee.
Empidonax minimus, Least Flycatcher.
Empidonax wrighti, Wright Flycatcher.
Empidonax hammondi, Hammond Flycatcher. *C.*
Otocoris alpestris leucolæma, Desert Horned Lark. *U.*
Pica pica hudsonia, Magpie.
Cyanocephalus cyanocephalus, Pinyon Jay. *U.*
Dolichonyx oryzivorus, Bobolink. *U.*
Euphagus cyanocephalus, Brewer Blackbird. *U.*
Calcarius ornatus, Chestnut-collared Longspur. *U.*
Rhynchophanes mccowni, McCown Longspur.
Poœcetes gramineus confinis, Western Vesper Sparrow. *U.*
Passerculus sandwichensis alaudinus, Western Savannah Sparrow. *U.*
Spizella passerina arizonæ, Western Chipping Sparrow.
Spizella breweri, Brewer Sparrow. *U.*
Junco aikeni, White-winged Junco.
Melospiza melodia montana, Mountain Song Sparrow.
Passerella iliaca schistacea, Slate-colored Fox Sparrow.
Pipilo maculatus arcticus, Arctic Towhee.
Oreospiza chlorura, Green-tailed Towhee.
Zamelodia melanocephala, Black-headed Grosbeak. *U.*
Piranga ludoviciana, Western Tanager.
Tachycineta thalassina lepida, Northern Violet-green Swallow. *C.*
Vireosylva gilva swainsoni, Western Warbling Vireo.
Lanivireo solitarius plumbeus, Plumbeous Vireo.
Dendroica auduboni, Audubon Warbler. *C.*
Dendroica nigrescens, Black-throated Gray Warbler.[3]
Seiurus aurocapillus, Oven-bird. *C.*
Oporornis tolmiei, Macgillivray Warbler. *C.*
Oreoscoptes montanus, Sage Thrasher. *U.*
Salpinctes obsoletus, Rock Wren. *U.*
Troglodytes aëdon parkmani, Western House Wren. *U.*
Sitta carolinensis nelsoni, Rocky Mountain Nuthatch.
Sitta pygmæa, Pygmy Nuthatch.
Penthestes atricapillus septentrionalis, Long-tailed Chickadee. *U.*
Hylocichla fuscescens salicicola, Willow Thrush.
Planesticus migratorius propinquus, Western Robin. *C.*
Sialia currucoides, Mountain Bluebird. *C.*

[1] Observed during breeding season.
[2] Taken during breeding season.
[3] Probably breeds.

PLANTS—TRANSITION ZONE.

[Species marked *U.* occur also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Trees and shrubs.

Pinus scopulorum, Yellow Pine, Rock Pine.
Juniperus scopulorum, Rocky Mountain Juniper. *U.*
Juniperus sabina, Creeping Juniper, Trailing Savin.
Populus angustifolia, Narrow-leaved Cottonwood.
Salix bebbiana, Bebb Willow. *C.*
Salix cordata watsoni, Diamond Willow. *U.*
Salix mackenziana, Diamond Willow.
Salix scouleriana, Willow.
Betula fontinalis, Rocky Mountain Birch.
Quercus macrocarpa, Bur Oak.
Berberis aquifolium, Barberry, Oregon Grape.
Grossularia inermis, Gooseberry.
Ribes inebrians, Red Currant.
Ribes americanum, Currant.
Edwinia americana.
Cercocarpus ledifolius, Mountain Mahogany.
Cercocarpus intricatus, Mountain Mahogany.
Cercocarpus parvifolius, Mountain Mahogany. *U.*
Kunzia tridentata.
Holodiscus dumosus.
Opulaster monogynus, Ninebark.
Opulaster pubescens, Ninebark.
Opulaster malvaceus, Ninebark.
Rubus deliciosus, Flowering Raspberry.
Melanchier alnifolia, Serviceberry.
Melanchier elliptica, Serviceberry.
Melanchier oreophila, Serviceberry.
Cratægus rivularis, Black Hawthorn.
Cratægus cerronis, Hawthorn.
Cratægus sheridana, Red Hawthorn.
Prunus melanocarpa, Chokecherry.
Prunus pennsylvanica, Wild Red Cherry. *C.*
Acer glabrum, Mountain Maple. *C.*
Acer grandidentatum, Large-toothed Maple.
Ceanothus velutinus, Mountain Balm.
Ceanothus fendleri, Wild Tea Bush.
Ceanothus mollissimus.
Elæagnus argentea, Silverberry.
Cornus stolonifera, Cornel.
Cornus instolonea, Cornel.
Arctostaphylos uva-ursi, Bearberry.
Sambucus canadensis, Elderberry.
Sambucus melanocarpa, Mountain Black Elderberry. *C.*
Viburnum lentago, Sweet Viburnum.
Symphoricarpos rotundifolius, Snowberry.
Symphoricarpos oreophilus, Mountain Snowberry.
Symphoricarpos pauciflorus, Snowberry.
Lonicera glaucescens, Douglas Honeysuckle.
Chrysothamnus wyomingensis, Rabbit Brush.
Chrysothamnus pulcherrimus, Rabbit Brush.
Chrysothamnus parryi, Rabbit Brush.
Chrysothamnus frigidus, Rabbit Brush.
Artemisia tridentata, Black Sagebrush. *U.*
Artemisia cana, Gray Sagebrush. *U.*
Artemisia trifida, Sagebrush.
Artemisia arbuscula, Brown Sagebrush.
Artemisia frigida, Sagebrush.
Artemisia ludoviciana, Sagebrush. *U.*

Herbaceous plants.

Calochortus gunnisoni, Mariposa Lily.
Calochortus nuttalli, Mariposa Lily.
Zygadenus venenosus, Poison Camas. *U.*
Iris missouriensis, Blue Flag.
Corallorhiza multiflora, Coral Root. *C.*
Humulus lupulus, Wild Hop.
Lewisia rediviva, Bitter Root.
Arenaria congesta, Sandwort. *C.*
Clematis ligusticifolia, White Virgin's Bower.
Clematis douglasi, Purple Virgin's Bower.
Clematis occidentalis, Virgin's Bower.

PLANTS—TRANSITION ZONE—Continued.

Herbaceous plants—Continued.

Anemone cylindrica, Anemone. *U.*
Cyrtorhyncha ranunculina, Nuttall Buttercup.
Physaria didymocarpa, Double Bladder-pod.
Drymocallis glandulosa, Glandular Cinquefoil. *C.*
Potentilla effusa, Cinquefoil.
Thermopsis rhombifolia, Yellow Thermopsis.
Lupinus argenteus, Silvery Lupine.
Astragalus succulentus, Ground Plum. *U.*
Astragalus drummondi, Drummond Milk Vetch.
Astragalus hypoglottis, Milk Vetch. *U.*
Astragalus flexuosus, Milk Vetch. *U.*
Astragalus nitidus, Milk Vetch.
Astragalus calycosus, Milk Vetch.
Aragallus lamberti. *U.*
Psoralea argophylla, Silvery Psoralea.
Hedysarum cinerascens, Hedysarum.
Hedysarum uintahense, Uinta Hedysarum. *C.*
Vicia americana, Vetch. *U.*
Geranium fremonti, Geranium. *C.*
Geranium richardsoni, Geranium. *C.*
Linum lewisi, Wild Flax.
Opuntia fragilis, Small-jointed Cactus. *U.*
Echinocactus simpsoni, Simpson Ball Cactus. *C.*
Pachylophus montanus, Evening Primrose. *U.*
Harbouria trachypleura, Water Hemlock. *C.*
Aralia nudicaulis, Wild Sarsaparilla.
Gentiana affinis, Gentian. *C.*
Apocynum androsæmifolium, Indian Hemp.
Phlox depressa, Wild Phlox.
Phlox hoodi, Wild Phlox.
Gilia congesta, Gilia.
Phacelia linearis, Phacelia.
Phacelia heterophylla, Phacelia.
Oreocarya virgata, Oreocarya.
Monarda menthæfolia, Horse Mint. *U.*
Pentstemon laricifolius, Beard-tongue.
Adenostegia ramosa. *U.*
Scutellaria brittoni, Skullcap. *U.*
Mimulus floribundus, Monkey Flower.
Orthocarpus luteus, Yellow Orthocarpus.
Campanula rotundifolia, Harebell. *C.*
Antennaria reflexa, Everlasting.
Balsamorrhiza sagittata, Balsam Root.
Balsamorrhiza incana, Balsam Root.
Chænactis douglassi.

Grasses.

Savastana odorata, Holy Grass.
Stipa nelsoni, Feather Grass.
Muhlenbergia comata, Dropseed Grass.
Agrostis hiemalis, Bent Grass. *C.*
Kœleria cristata, June Grass. *U.*
Poa longipedunculata, Long-stalked Spear Grass. *C.*
Poa lucida, Spear Grass.
Panicularia nervata, Manna Grass.
Festuca ovina duriuscula, Fescue Grass.
Bromus marginatus, Brome Grass.
Bromus porteri, Brome Grass.
Agropyron pseudorepens, Wheat Grass. *C.*
Agropyron caninum, Wheat Grass.
Agropyron spicatum, Wheat Grass. *U.*

Agricultural Utility of the Transition Zone.

The elevated Transition area with its vast extent of grazing lands is now, as in the past, the center of the sheep and cattle industries of Wyoming, and there are also extensive coal and oil fields in various stages of development. The principal timberlands in the Transition Zone are of small extent and lie to the east and northeast. They comprise a moderate growth of yellow pine on the Laramie (see

Pl. V, fig. 1), Casper, and Bear Lodge Mountains, and heavy forests of this valuable timber on the western slopes of the Black Hills.[1]

The climate is cool but dry and healthful, with a rainfall varying from 10 to 12 inches in the arid parts, 12 to 15 inches in the east-central and southeast sections, and 17 to 21 inches in the Black Hills and Bear Lodge districts at the northeast where crops succeed moderately in all except the sagebrush lands. The snowfall is rather heavy throughout. This quantity of moisture, though not large, in a measure counterbalances the cool climate of the Transition Zone and, combined with the much greater area, gives this zone an agricultural value in Wyoming comparable to that of the warmer Upper Sonoran. Large areas of excellent grass land in the mountain valleys and on the higher plateaus in the upper part of the zone are ideal either as cattle range or for the summer grazing of sheep, while a fair growth of range grasses generally obtains even in the lower, more arid sections. The rich soils yield abundantly either under dry farming or irrigation wherever there has been a proper selection of hardy, quick-maturing crops adapted to a usually short growing season.

High-altitude farming has been thoroughly tested at the Wyoming Experiment Station at Laramie for a series of years. Very favorable results[2] were obtained with a great variety of vegetable and cereal crops and even certain fruits, in experiments conducted in the heart of the Transition Zone at over 7,000 feet elevation, where bleak winds are unusually prevalent. Apples and small fruits which are grown with considerable difficulty on the Laramie Plains succeed admirably in many localities with greater natural protection. Successful farming districts in the Wyoming Transition include sections of the Laramie Plains, the Platte Valley above Saratoga, Bear Valley and Fort Bridger region in Uinta County, Salt River Valley in Lincoln County, the eastern base of the Bighorn Mountains in Sheridan and Johnson Counties, and the Sundance region in Crook County. In most of these, oats and hardy cereals, alfalfa (two cuttings), field peas, potatoes, and hardy vegetables are raised to great perfection. Hay, forage, garden vegetables, and a limited crop of small grain are very generally grown on stock ranches even in the colder parts of the zone.

CANADIAN ZONE.

The Canadian Zone, the region of coniferous Boreal forest, is the most important of the Boreal transcontinental life areas. It extends far southward in the principal mountain masses of the Western

[1] Open sage country usually fills the zone on the basal slopes of the high ranges in western Wyoming. The growth of Douglas spruce along its upper border in this region is generally scattering, while the yellow pine is of rare occurrence.

[2] Discussed in bulletins of the Wyoming Experiment Station, which contain also valuable cultural and other data based on tests made at the station at Laramie and at the experimental farms at Sundance and Saratoga.

States, and over much of the Rocky Mountain region covers the middle slopes of the high ranges and the summits and upper slopes of mountains of medium elevation. It is uniformly and conspicuously characterized from Montana to Colorado by forests of spruce, fir, lodgepole pine, and aspen, and by a large variety of Boreal undershrubs and plants.

In Wyoming the greatest extent of Canadian Zone country is in the mountainous northwest. Here the zone includes most of the extensive undulating forested plateau of Yellowstone Park; large rolling or hilly tracts of mixed forest and open country on the borders of Jackson Hole (Pl. VIII, fig. 1), in the basin of Hoback River, at the head of Green River, and on the southern end of the Wyoming Range; and the forested slopes of the Wind River, Absaroka, Teton, Gros Ventre, Salt River, Snake River, and Wyoming Ranges (Pl. VIII, fig. 2) from near their bases to the upper limit of large tree growth at 9,000 to 10,000 feet elevation. Elsewhere the Bighorn and Medicine Bow Ranges and the Sierra Madre are extensively Canadian, and the Laramie Mountains and Casper Range have considerable areas on their summits. Elevations of medium altitude which are capped with Canadian Zone forests and also have small areas on their cool slopes are the Black Hills, the Bear Lodge, Rattlesnake, Green, Ferris, Seminole, and Shirley Mountains, the northern shoulders of the Uinta Mountains, and high plateaus along the southern boundary of the State between Green River and the Red Desert. Traces of the zone, indicated usually by aspens and lodgepole pines, or merely by dense, scrubby thickets of aspens, are on the upper, cool slopes of the Aspen Mountains, the Bear River Divide, a few desert peaks along the continental watershed between South Pass and Steamboat Mountain, on Heart Mountain north of Cody, and on Pyramid and Heaths Peaks along the upper Platte.

The lofty Wind River Range of comparatively straight axis presents a graphic view of the Canadian forest belt, which is maintained usually at uniform elevation and in full vertical width (about 2,000 feet) on both slopes, its lower border sharply defined where the forests meet the open basal sagebrush country of the Transition Zone.[1] The upper border of the Canadian Zone is obscure in these mountains, as elsewhere, the change from heavy forest growth to the narrow Hudsonian timberline belt of dwarfed forest being gradual and almost imperceptible.

The main forest composition on the Wyoming mountains is very uniform, with forests of lodgepole pine and aspen in the lower half of the zone and a heavy stand of Engelmann spruce, or more often

[1] The lower edge of the Canadian Zone is less clearly marked on the eastern slopes of the Bighorn Mountains and elsewhere in eastern Wyoming where forests of yellow pine fill much of the upper Transition.

a mixed forest of spruce and fir, higher up. Other trees of less extensive growth and more restricted distribution are the Douglas spruce in the lower part of the zone, chiefly in the northwestern mountains; the blue spruce and balsam poplar fringing streams along the lower edge of the zone in the south and west, and in the northwest, respectively; and the canoe birch in the Black Hills and Bear Lodge Mountains. Fire-swept tracts usually are first covered with a dense growth of young aspens, which are of more rapid growth than conifers. In the Sierra Madre the fresh growth on burned-over areas is occasionally of fir over original lodgepole pine forest.

In the lower part of the Canadian forest belt are considerable areas of partly open mountain meadows and parks, and more rarely, of open slopes. Characteristic tracts are the 8,000-foot watershed between the Hoback and Green Rivers, where groves of aspen intermixed with a little lodgepole pine and fir alternate over a gently rolling country with open parks covered with low matted sagebrush, *Frasera*, and *Balsamorrhiza*, or with beautiful grassy meadows brilliantly colored in summer with flowers of shrubby cinquefoil, larkspur, lupine, geranium, iris, and painted cup; the grassy meadows and bordering sage benches of the Du Noir Valley at the head of Wind River; extensive willow-grown meadows and flats at the northern end of Jackson Hole and in Yellowstone Park; and open grass or sage slopes on the western side of the Bighorn Mountains between 8,000 and 9,000 feet elevation. On the moderately inclined eastern side of the Wyoming Range southwest of Bigpiney are unusually open mountain slopes. Here grass and sage country extend in many places on ridges and south slopes to the 10,000-foot crest of the range, alternating regularly with dense tracts of Douglas spruce, lodgepole pine, and Engelmann spruce forest on all north slopes and in gulches.

The usual factors of base level, latitude, slope incline and exposure, and, to a certain extent, air currents, affect in varying degree the altitude of the Canadian Zone. Base level appears to be more potent than latitude in Wyoming. The variation from 8,500 to 10,500 feet on southwest slopes and 7,500 to 9,500 feet on northeast slopes in the mountains along the southern boundary and bordering Green River Basin, to 8,000 to 9,500 feet on southwest slopes and 7,000 to 9,000 feet on northeast slopes in the northern mountains, is largely latitudinal. The depression to 6,000 feet on the cap of the Black Hills and Bear Lodge Mountains, however, is probably due to the low base level of the adjacent plains on the north and east.

The high level of the Canadian Zone (above 8,000 feet) on the warm western slope of the Bighorn Mountains east of Ionia is due to bold southwest exposure, which more than offsets the lowering

B11824

FIG. 1.—SNAKE RIVER VALLEY (6,500 FEET) NEAR MORAN, JACKSON HOLE.

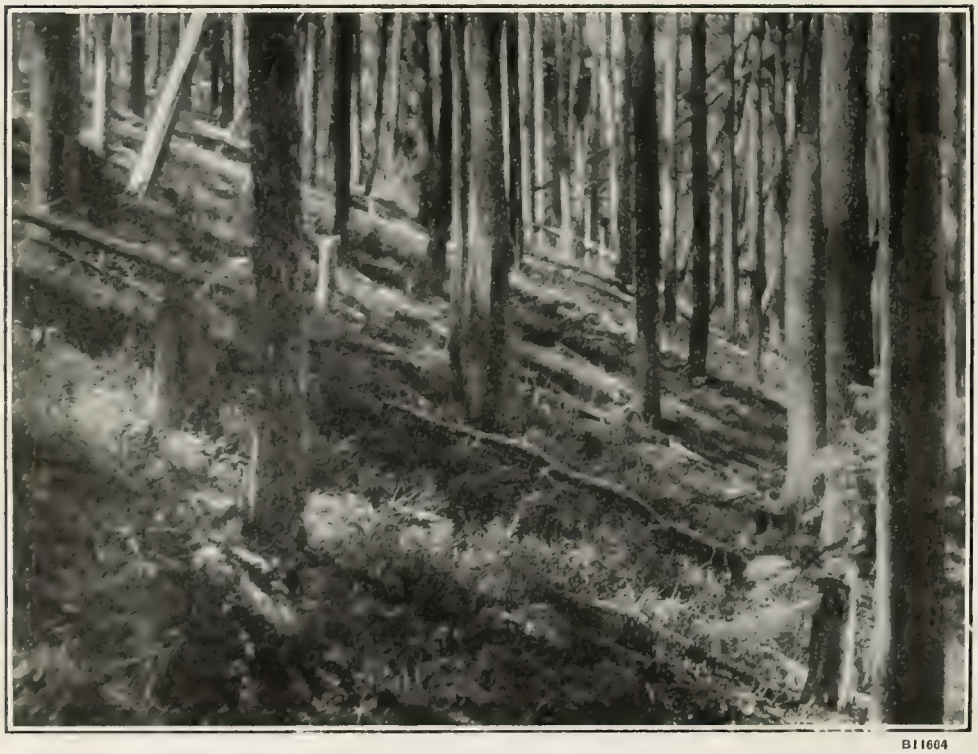
Mixed forest conditions at lower edge of Canadian Zone are shown. Scattered groves of aspen, balsam poplar, and blue spruce on valley flats; aspen and lodgepole pine forests on hills.

B13670

FIG. 2.—HEAVY ENGELMANN SPRUCE FOREST WYOMING RANGE WEST OF MERNA (9,000 FEET).

B11804

FIG. 1.—SYLVAN LAKE, YELLOWSTONE NATIONAL PARK, IN THE ENGELMANN SPRUCE BELT.



B11604

FIG. 2.—HEAVY STAND OF LODGEPOLE PINE, NORTH SLOPE OF FERRIS MOUNTAINS (8,500 FEET).

influence of the low altitude of the Bighorn Basin at their western bases. The Ferris and Green Mountains, small isolated ranges on the northern border of the Red Desert, show graphically the effect of slope exposure on zone level. The Ferris Range, of 9,500 feet elevation, is narrow and sharp-crested, with very abrupt southwest slopes facing the desert. These hot, exposed slopes are open Transition Zone, and crowd the Canadian element above 9,000 feet, where it is indicated just below the summit by thickets of aspen and lodgepole pine in gulches, and by Rocky Mountain white pine on exposed slopes and ridges. Just over the 9,500-foot crest on the cool exposure are the Engelmann spruces and firs of the Canadian Zone, somewhat dwarfed at first but soon encountered in large and dense growth. The spruces and firs, with lodgepole pines and aspens lower down, form a heavy forest on the northeast slopes down to 7,800 feet, while descending tongues in gulches along cold streams extend 500 feet lower. The Canadian Zone on the Ferris Range thus exhibits about the maximum variation in zone level due to slope exposure—fully 1,500 feet.

In Jackson Hole, the Yellowstone Valley, along both forks of the Shoshone River, and at the heads of many other narrow valleys deeply penetrating the mountain mass of northwest Wyoming the Canadian element reaches a low elevation, and on cold slopes is often unmixed with Transition species at 6,000 feet. Over this region the mean summer temperature is low, the cold air of the surrounding mass of Boreal country settling into the valleys and canyons at night, and frequent frosts occur during the warmest months. Furthermore, these mainly steep-walled valleys receive a minimum of sunlight, and many slopes are shaded during the warmest part of the day. Under these conditions the zone occasionally has a vertical breadth of nearly 3,000 feet, since the factors which cause the abnormal depression of its lower boundary do not appreciably affect the upper limit.

The cooling influence of cold streams and of descending cold air currents which flow down gulches and canyons regularly carries narrow tongues of Canadian Zone far below the average level on mountain slopes. This is very noticeable on some of the streams at the southwestern base of the Wind River Range. The clear icy waters of Pine Creek, the outlet of Fremont Lake, carry a broad fringe of lodgepole pines, aspens, and a pure Canadian undergrowth almost to its junction with the New Fork at 7,000 feet elevation, fully 1,000 feet below the mean lower border of the zone on the southwest slope of these mountains. The waters of the Big Sandy, 40 miles to the southeast, also carry Canadian species far down into open Transition sagebrush country. Streams which break out of the steep northern escarpment of the Casper Range through deep, shaded gulches are

heavily fringed with aspen groves and Canadian undershrubs on the otherwise open 6,000-foot basal slopes, 1,000 feet below the usual altitude of these species on the northern slopes of this range.

The Canadian Zone is marked in Wyoming as a cool region of considerable humidity, but the percentage of bright sunny days throughout the year is high. Much of the precipitation is in the form of frequent sharp showers in summer and heavy snows in winter, but there are occasional rains of greater duration in spring and fall. The chief value of this zone is its natural adaptation, in abundant forest and plant cover and cool summer temperature, to moisture retention.[1] The extensive forests, its greatest natural resource, are now largely under Federal control. These are of great value, especially the forests of lodgepole pine and Engelmann spruce (Pl. IX), but large areas are as yet inaccessible. Winter temperatures are low, occasionally reaching —45° F., and in the small areas physically adapted to agriculture the prevalent summer frosts preclude the growing of more than a few of the hardiest crops and vegetables for ranch use.

Characteristic Species—Canadian Zone.

A rich fauna and flora uniformly characterize the Canadian Zone in Wyoming. Forest species predominate, many of them identical with or closely related to Boreal types of transcontinental range from Labrador to Alaska; others are peculiar to the Rocky Mountain region; and a small number have a restricted range. The canoe birch, beaked hazelnut, Douglas honeysuckle, northern chipmunk, and a few other species of wide Boreal dispersion occur only in the outlying Black Hills and Bear Lodge Mountains at the northeast, and the northern varying hare only in the Bighorn Mountains, but elsewhere the characteristic species are very uniformly distributed in the different mountain ranges. With the exception of many of the breeding birds, which merely make their summer home in the Canadian Zone, all are species adapted to a region of long, cold winters and short, cool summers.

Mammals—Canadian Zone.

[Species marked *T.* occur also in the Transition Zone; those marked *H.*, also in the Hudsonian.]

Cervus canadensis canadensis, Elk. *T, H.*

Alces americanus shirasi, Shiras Moose.

Sciurus fremonti fremonti, Fremont Spruce Squirrel.

Sciurus hudsonicus baileyi, Bighorn Red Squirrel.

Sciurus hudsonicus ventorum, Rocky Mountain Red Squirrel.

Glaucomys sabrinus bangsi, Rocky Mountain Flying Squirrel.

Eutamias borealis, Northern Chipmunk.

Eutamias operarius, Colorado Chipmunk.

[1] See pp. 52–53.

MAMMALS—CANADIAN ZONE—Continued.

Eutamias umbrinus, Uinta Chipmunk.
Eutamias luteiventris, Buff-bellied Chipmunk. *T.*
Callospermophilus lateralis lateralis, Say Ground Squirrel. *T.*
Callospermophilus lateralis caryi, Wind River Mantled Ground Squirrel.
Callospermophilus lateralis castanurus, Chestnut-tailed Ground Squirrel.
Marmota flaviventris nosophora, Golden-mantled Marmot. *H.*
Marmota flaviventris luteola, Park Marmot. *H.*
Marmota flaviventris dacota, Black Hills Marmot. *T.*
Peromyscus maniculatus artemisiæ, Sagebrush White-footed Mouse. *T.*
Peromyscus maniculatus rufinus, Tawny White-footed Mouse.
Phenacomys orophilus, Mountain Phenacomys.
Evotomys gapperi galei, Gale Red-backed Mouse.
Evotomys brevicaudus, Black Hills Red-backed Mouse.
Microtus mordax mordax, Rocky Mountain Meadow Mouse.
Microtus longicaudus, Long-tailed Meadow Mouse. *T.*
Microtus richardsoni macropus, Big-footed Meadow Mouse.
Microtus nanus nanus, Dwarf Field Mouse. *T*, *H.*
Castor canadensis, Beaver. *T.*
Thomomys fossor, Colorado Pocket Gopher.
Thomomys uinta, Uinta Pocket Gopher. *H.*
Thomomys fuscus fuscus, Brown Pocket Gopher.
Thomomys talpoides caryi, Bighorn Pocket Gopher. *H.*
Zapus princeps princeps, Rocky Mountain Jumping Mouse.
Erethizon epixanthum, Yellow-haired Porcupine. *T.*
Lepus americanus americanus, Northern Varying Hare.
Lepus bairdii bairdii, Snowshoe Rabbit.
Felis hippolestes, Mountain Lion. *T.*
Lynx canadensis canadensis, Canada Lynx.
Vulpes macrourus, Mountain Red Fox.
Mustela arizonensis, Arizona Weasel. *T.*
Mustela cicognanii leptus, Dwarf Weasel.
Martes caurina origenes, Rocky Mountain Marten.
Lutra canadensis canadensis, Otter. *T.*
Gulo luscus, Wolverene.
Ursus americanus, Black Bear. *T.*
Ursus imperator, Yellowstone Park Grizzly Bear. *T.*
Ursus washake, Washakie Grizzly Bear, Silver-tip. *T.*
Sorex personatus personatus, Masked Shrew. *H.*
Sorex obscurus obscurus, Rocky Mountain Shrew. *H.*
Sorex vagrans dobsoni, Dobson Shrew.
Neosorex palustris navigator, White-bellied Water Shrew.
Nycteris cinerea, Hoary Bat. *T.*
Lasionycteris noctivagans, Silver-haired Bat. *T.*
Myotis lucifugus carissima, Little Brown Bat. *T.*

BREEDING BIRDS—CANADIAN ZONE.

[Species marked *T.* breed also in the Transition Zone; those marked *H.*, also in the Hudsonian.]

Pelecanus erythrorhynchos, White Pelican.
Mergus americanus, Merganser. *T.*
Clangula islandica, Barrow Goldeneye. *H.*
Charitonetta albeola, Buffle-head.
Branta canadensis, Canada Goose. *T.*
Olor buccinator,[1] Trumpeter Swan. *T.*
Dendragapus obscurus richardsoni, Richardson Dusky Grouse. *T.*
Picoides arcticus, Arctic Three-toed Woodpecker.

[1] Probably no longer breeding in Wyoming.

BREEDING BIRDS—CANADIAN ZONE—Continued.

Picoides americanus dorsalis, Alpine Three-toed Woodpecker. *H.*
Sphyrapicus varius nuchalis, Red-naped Sapsucker. *T.*
Sphyrapicus thyroideus, Williamson Sapsucker.
Sclasphorus platycercus, Broad-tailed Hummingbird. *T.*
Nuttallornis borealis, Olive-sided Flycatcher.
Empidonax difficilis, Western Flycatcher. *T.*
Cyanocitta stelleri annectens, Black-headed Jay.
Perisoreus canadensis capitalis, Rocky Mountain Jay. *H.*
Carpodacus cassini, Cassin Purple Finch.
Loxia curvirostra minor, Crossbill.
Spinus pinus, Pine Siskin.
Zonotrichia leucophrys, White-crowned Sparrow. *H.*
Junco hyemalis mearnsi, Pink-sided Junco. *H.*
Junco phæonotus caniceps, Gray-headed Junco. *H.*
Melospiza lincolni, Lincoln Sparrow.
Wilsonia pusilla pileolata, Pileolated Warbler. *H.*
Cinclus mexicanus unicolor, Dipper, Water Ouzel. *T.*
Nannus hiemalis pacificus, Western Winter Wren.
Sitta canadensis, Red-breasted Nuthatch.
Penthestes gambeli, Mountain Chickadee. *T.*
Regulus satrapa, Golden-crowned Kinglet. *H.*
Regulus calendula, Ruby-crowned Kinglet.
Myadestes townsendi, Townsend Solitaire. *T.*
Hylocichla ustulata swainsoni, Olive-backed Thrush. *T.*
Hylocichla guttata auduboni, Audubon Hermit Thrush.
Sialia currucoides, Mountain Bluebird. *T.*

PLANTS—CANADIAN ZONE.

[Species marked *T.* occur also in the Transition Zone; those marked *H.*, also in the Hudsonian.]

Trees and shrubs.

Pinus murrayana, Lodgepole Pine.
Pinus flexilis, Rocky Mountain White Pine. *T, H.*
Picea engelmanni, Engelmann Spruce.
Picea parryana, Blue Spruce.
Abies (concolor?), White Fir.
Pseudotsuga mucronata, Douglas Spruce. *T.*
Juniperus sibirica, Low Juniper. *H.*
Populus tremuloides, Aspen.
Populus balsamifera, Balsam Poplar.
Salix pyrifolia obscura, Willow.
Salix nelsoni, Nelson Willow. *H.*
Betula papyrifera, Canoe Birch.
Betula glandulosa, Dwarf Birch.
Corylus rostrata, Hazelnut. *T.*
Alnus tenuifolia, Alder.
Ribes petiolare, Mountain Black Currant.
Ribes wolfi, Blue Currant.
Ribes lacustre, Currant.
Ribes viscosissimum, Currant.
Spiræa lucida, Meadowsweet. *T.*
Rubus parviflorus, Thimbleberry.
Rubus strigosus, Red Raspberry. *T.*
Dasiphora fruticosa, Shrubby Cinquefoil. *H.*
Rosa sayi, Rose. *T.*
Sorbus scopulina, Mountain Ash.
Pachystima myrsinites.
Rhamnus alnifolia, Buckthorn.
Lepargyrea canadensis, Canadian Buffaloberry.
Ledum glandulosum, Labrador Tea.
Menziesia ferruginea.
Vaccinium oreophilum, Mountain Blueberry.

PLANTS—CANADIAN ZONE—Continued.

Trees and shrubs—Continued.

Vaccinium erythrococcum, Red Bilberry. *H.*
Vaccinium occidentale, Blueberry.
Vaccinium cæspitosum, Blueberry.
Sambucus microbotrys, Red Elderberry.
Lonicera glaucescens, Douglas honeysuckle.
Lonicera involucrata, Involucred Flyhoneysuckle.
Lonicera utahensis, Honeysuckle.

Herbaceous plants.

Veratrum tenuipetalum, White Hellebore.
Zygadenus elegans, Beautiful Camas. *H.*
Calochortus pavonaceus, Yellow Mariposa.
Erythronium parviflorum, Dog-tooth Violet. *H.*
Streptopus amplexifolius, Twisted-stalk.
Disporum trachycarpum. *T.*
Limnorchis borealis, Bog Orchid.
Calypso bulbosa, Calypso.
Rumex paucifolius, Dock. *H.*
Claytonia rosea, Spring Beauty. *H.*
Actæa arguta, Baneberry.
Actæa rubra, Baneberry.
Aquilegia cærulea, Blue Columbine.
Aquilegia flavescens, Yellow Columbine.
Aquilegia oreophila, Columbine. *H.*
Anemone lithophila, Anemone.
Aconitum columbianum, Monkshood.
Clematis pseudalpina, Purple Virgin's Bower.
Ranunculus inamœnus, Crowfoot.
Thlaspi glaucum, Penny Grass. *H.*
Parnassia fimbriata, Grass-of-Parnassus.
Heuchera parvifolia, Alum Root. *H.*
Micranthes arguta, Saxifrage.
Fragaria pauciflora, Strawberry. *T.*
Sieversia ciliata, Mountain Avens.
Astragalus alpinus, Milk Vetch.
Trifolium rydbergi, Clover. *T.*
Trifolium anemophilum, Clover. *T.*
Geranium parryi, Geranium.
Geranium cæspitosum, Geranium. *T.*
Viola canadensis rydbergi, Violet.
Viola bellidifolia, Violet. *H.*
Epilobium spp.
Heracleum lanatum.
Pyrola secunda, Wintergreen.
Pyrola uliginosa, Wintergreen.
Pyrola chlorantha, Wintergreen.
Pyrola elliptica, Wintergreen.
Pyrola picta, Painted Wintergreen.
Pterospora andromeda, Pinedrops. *T.*
Chimaphila umbellata, Pipsissewa.
Moneses uniflora, One-flowered Wintergreen.
Gentiana forwoodi, Closed Gentian.
Gentiana elegans, Mountain Fringed Gentian.
Frasera speciosa, Frasera.
Pentstemon glaucus, Beard-tongue.
Pentstemon fruticosus, Beard-tongue. *T.*
Mimulus langsdorfii, Monkey Flower.
Mimulus lewisi, Crimson Monkey Flower.
Elephantella grœnlandica, Elephant-head. *H.*
Pedicularis racemosa, Purple Lousewort.
Castilleja sulphurea, Painted Cup.
Linnæa americana, Twinflower.
Valeriana acutiloba, Valerian. *H.*
Anaphalis subalpina, Pearly Everlasting.
Antennaria pulcherrima, Everlasting. *T.*
Wyethia amplexicaulis.
Arnica cordifolia, Heart-leaved Arnica.

PLANTS—CANADIAN ZONE—Continued.

Grasses.

Phleum alpinum, Alpine Timothy. *H.*
Alopecurus occidentalis, Mountain Foxtail.
Calamagrostis canadensis acuminata, Mountain Reed Grass.
Deschampsia cæspitosa, Tufted Hair Grass. *T.*
Danthonia intermedia, Mountain Oat Grass.
Poa reflexa, Mountain Bluegrass. *H.*
Festuca thurberi, Thurber Fescue.
Agropyron violaceum, Wheat Grass. *H.*
Elymus glaucus, Rye Grass. *T.*

HUDSONIAN ZONE.

On the high mountain ranges of the Western States the Canadian forest belt is fringed along its upper edge by the narrow Hudsonian strip of dwarfed forest and depauperate vegetation, which gives way to bare Alpine slopes along a sharply defined climatic boundary known as timberline, corresponding to the transcontinental limit of trees at the southern edge of the Arctic tundras. The Hudsonian Zone occupies a relatively small area in Wyoming. It encircles the Alpine summits and crests of the northwestern ranges, including the Bighorn Mountains, and small areas cap all ranges or isolated peaks which approximate timberline altitudes. A belt bounds the Alpine cap of the Snowy Mountains at the northern end of the Medicine Bow Range, and small, widely separated tracts or islands are on Bridger Peak and neighboring summits of the Sierra Madre, on Elk Mountain, and on Laramie Peak.

In the southern mountains the forests commence to dwarf almost imperceptibly at from about 10,000 to 10,500 feet altitude, according to slope exposure, the elevation decreasing with higher latitude to 9,000 or 9,500 feet in northern Wyoming. The vertical breadth of the Hudsonian belt varies with slope and soil conditions from a few hundred to 1,000 feet. The peculiar ruggedness and broken, incised character of many mountains greatly obscures this belt, while in places sheer, perpendicular cliffs and avalanches greatly contract it or even narrowly interrupt continuity. Avalanches sweep away every vestige of tree growth and in many places replace the original soil with extensive fields of slide rock. The result is not a climatic change, however, and can not be considered in delimiting the zone. The Hudsonian strip is usually widest in cold gulches with abundant soil, and is narrow on exposed, scantily soiled ridges. In fact, soil conditions often counterbalance the elevating influence of slope exposure, and tree growth may be found as high on cold well-soiled slopes as on warm rocky inclines.

An almost Arctic climate prevails in the Hudsonian Zone, which in winter is buried under deep snow and in summer is flecked with huge drifts, many of which never entirely leave protected gulches. The deep-soiled slopes are thoroughly saturated in summer by

melting snow and frequent showers and squalls of snow or sleet, and bogs and small lakes abound in all level situations and natural basins. Exposed to high winds throughout the year, the conifers are in ragged, fantastic, and usually one-sided growth, and, along with the shrubs and many larger plants, evidence an adverse climate in stunted and otherwise deficient development. (Pl. X.) The middle of May found the timberline region on the Wind River Range near Dubois still in the grasp of wintry weather, with few plants in flower and the low willows and shrubby cinquefoil not yet in leaf; while on the Bighorn Mountains east of Hyattville the alpine willows had not put forth leaves by June 5. Many plants were past flowering, and herbaceous vegetation was partly dried up on the Wyoming Range at 10,400 feet altitude, August 9; and the timberline slopes on the Tetons were sere and brown on August 30 except for the hardy, late-flowering blue gentians.

Although the climate is rigorous for eight months of the year and myriads of mosquitoes greet one in summer, this highly interesting region well repays the arduous climb entailed to reach its confines. The gently rounding crests of the Wyoming Range south of Hoback Peak are peculiarly attractive. Grassy openings and parks mingle with scattered clumps and mats of Engelmann spruce and alpine fir; fields of scarlet painted cup, blue larkspur, white columbine, and purple lupine enliven a landscape flecked with white banks of melting snow; and a moderate incline adds to the beauty of the region. The Hudsonian area on the southwest side of the Wind River Range is of very different character. South of Fremont Peak (Pl. XI, fig. 1) it occupies a sloping granitic plateau a mile or two wide, and between 10,500 and 11,200 feet altitude, at the base of abrupt Alpine peaks of nearly 14,000 feet elevation. Its exceedingly rough surface of a seemingly endless succession of bare granite hummocks, studded with countless clear, snow-fed lakes in rocky basins, makes travel extremely arduous. Vegetation is scanty, and coniferous growth is very scattering over this unusually rocky region. Hudsonian vegetation is most abundant on deep-soiled slopes, as on Whiskey Mountain in the Wind River Range south of Dubois, and along the eastern slope of Needle Mountain in the Absaroka Range (Pl. XI, fig. 2).

Characteristic Species—Hudsonian Zone.

Trees of the timberline belt in Wyoming are the alpine fir, white-barked pine, and Engelmann spruce. The first two are characteristic Hudsonian trees, but the spruce extends up from the Canadian Zone. The spruces and firs, mainly on cool exposures, exhibit to a marked degree the depressed growth due to high altitude and are usually prostrate mats at extreme timberline. The white-barked pines of the northwest ranges show less dwarfing, but usually are very ragged

and one-sided as a result of the prevalent winds. They occur in scattering growth or as compact tongues push up warm exposed slopes and ridges, and even form forests of considerable size a little below timberline, as on Whirlwind Peak, in the Absaroka Range. The Rocky Mountain white pine, although a tree usually found only at a lower altitude, was found near timberline on the Bighorn Mountains, and also on the exposed 10,000-foot summit of Laramie Peak, where its characteristic growth is in depressed mats at the base of a low central bole 6 feet or more in height. Prostrate clumps of low juniper are common in slide rock at timberline on the Sierra Madre, on the Bighorn and Wind River Ranges, and elsewhere.

Although prominently characterized by depauperate vegetation, the grassy slopes between the scattered clumps of conifers are handsomely carpeted with a wealth of small flowering plants. Conspicuous flowers of spring and early summer, as observed on the Wind River and Bighorn Ranges, include globe flower, mountain cowslip, shooting star, columbine, spring beauty, and various mertensias, Jacob's ladder, forget-me-nots, buttercups, saxifrages, and drabas. In early autumn the timberline region on the Wyoming and Absaroka Ranges was brilliant with flowering mats of lupine, larkspur, painted cup, mountain heath, and mountain laurel, with the more scattering Parry primroses, harebells, gentians, phloxes, and rydbergias.

Many of the plants of the Hudsonian Zone and most of the birds and mammals occur also in the adjoining Canadian or Arctic-Alpine Zones. Comparatively few species are closely restricted to this narrow area.

Mammals—Hudsonian Zone.

Mammals having their center of abundance at or near timberline are the mountain sheep (*Ovis canadensis canadensis*), the timberline chipmunk (*Eutamias oreocetes*), marmots (*Marmota flaviventris nosophora* and *M. f. luteola*), and the pika, or coney (*Ochotona uinta*). A number of species range into this region from the Canadian Zone, or make their homes in both areas. Those occurring thus with some regularity are:

Sciurus hudsonicus ventorum, Rocky Mountain Red Squirrel.

Callospermophilus lateralis caryi, Wind River Mantled Ground Squirrel.

Evotomys gapperi galei, Gale Red-backed Mouse.

Microtus mordax mordax, Rocky Mountain Meadow Mouse.

Microtus nanus nanus, Dwarf Field Mouse.

Thomomys uinta, Uinta Pocket Gopher.

Thomomys talpoides caryi, Bighorn Pocket Gopher.

Lepus bairdii bairdii, Snowshoe Rabbit.

Canis lestes, Mountain Coyote.

Vulpes macrourus, Mountain Red Fox.

Martes caurina origenes, Rocky Mountain Marten.

Sorex obscurus obscurus, Rocky Mountain Shrew.

Sorex personatus personatus, Masked Shrew.

B11790

FIG. 1.—ENGELMANN SPRUCES AT TIMBERLINE, WEST SLOPE OF WHIRLWIND PEAK, ABSAROKA RANGE (10,000 FEET).

B11791

FIG. 2.—WHITE-BARKED PINES, SAME LOCALITY.

B13641

FIG. 1.—LOWER EDGE OF HUDSONIAN ZONE, WIND RIVER RANGE SOUTH OF FREMONT PEAK (10,500 FEET).

B11759

FIG. 2.—EAST SLOPE OF NEEDLE MOUNTAIN, ABSAROKA RANGE.

Growth of Engelmann spruce, alpine fir, and gray-leaved willow (*Salix glaucops*) at timberline (10,000 feet).

B13645

FIG. 1.—ARCTIC-ALPINE ZONE, WIND RIVER RANGE.

South of Fremont Peak, from 11,600 feet elevation, July 17, 1911.

B11745

FIG. 2.—ARCTIC-ALPINE ZONE, ABSAROKA RANGE.

Between the Greybull and the South Fork of Shoshone River, from east slope of Needle Mountain (10,500 feet), July 11, 1910.

Breeding Birds—Hudsonian Zone.

[Species marked *C.* breed also in the Canadian Zone.]

Picoides americanus dorsalis, Alpine Three-toed Woodpecker. *C.*
Perisoreus canadensis capitalis, Rocky Mountain Jay. *C.*
Nucifraga columbiana, Clark Nutcracker.[1]
Pinicola enucleator montana, Rocky Mountain Pine Grosbeak.
Zonotrichia leucophrys, White-crowned Sparrow. *C.*
Junco hyemalis mearnsi, Pink-sided Junco. *C.*
Junco phæonotus caniceps, Gray-headed Junco. *C.*
Wilsonia pusilla pileolata, Pileolated Warbler. *C.*
Certhia familiaris montana, Rocky Mountain Creeper. *C.*
Regulus satrapa, Golden-crowned Kinglet. C.

Plants—Hudsonian Zone.

[Species marked *C.* occur also in the Canadian Zone; those marked *A.*, also in the Arctic-Alpine.]

Pinus albicaulis, White-barked Pine.
Picea engelmanni, Engelmann Spruce (dwarf). *C.*
Abies lasiocarpa, Alpine Fir (dwarf). *C.*
Juniperus sibirica, Low Juniper. *C.*
Salix glaucops, Gray-leaved Willow.
Salix chlorophylla, Willow. *C.*
Salix saximontana, Willow. *A.*
Ribes montigenum, Bristly Red Currant.
Rubus strigosus, Red Raspberry. *C.*
Polygonum bistortoides, Twisted Polygonum. *C.*
Claytonia rosea, Spring Beauty.
Calandrinia pygmæa, Alpine Bitter Root.
Cerastium beeringianum, Mouse-ear Chickweed.
Caltha leptosepala, Mountain Cowslip.
Trollius albiflorus, Globe Flower.
Aquilegia saximontana, Columbine.
Delphinium subalpinum, Larkspur.
Anemone tetonensis, Anemone.
Anemone globosa, Anemone. *C.*
Ranunculus alpeophilus, Buttercup.
Ranunculus calthæfolius, Buttercup.
Thlaspi glaucum, Penny Grass.
Draba luteola, Whitlow Grass.
Clementsia rhodantha, Red Orpine. *A.*
Leptasea hirculus, Saxifrage.
Potentilla glaucophylla, Cinquefoil. *C.*
Drymocallis pseudorupestris, Avens.
Lupinus cæspitosus, Lupine. *C.*
Lupinus laxiflorus, Lupine. *C.*
Trifolium dasyphyllum, Dwarf Clover. *A.*
Trifolium parryi, Parry Dwarf Clover. *A.*
Hedysarum sulphurescens.
Angelica roscana.
Phyllodoce empetriformis, Mountain Heath.
Kalmia polifolia, Mountain Laurel.
Primula parryi, Parry Primrose.
Androsace subumbellata.
Dodecatheon radicatum, Shooting Star. *C.*
Gentiana calycosa, Gentian.
Gentiana strictiflora, Gentian.
Swertia congesta, *A.*
Swertia palustris, *C.*
Phlox cæspitosa, Phlox. *C.*
Polemonium viscosum, Jacob's Ladder.
Polemonium mellitum, Jacob's Ladder.
Phacelia sericea, Silky Phacelia. *A.*
Myosotis alpestris, Forget-me-not. *A.*
Mertensia tweedyi, Lungwort. *C.*
Pentstemon alpinus, Beard-tongue.
Veronica wormskjoldi, Alpine Speedwell.
Veronica serpyllifolia, Speedwell. *C.*
Castilleja spp., Painted Cup.
Campanula parryi, Parry Harebell.
Rydbergia grandiflora, Rydbergia. *A.*

[1] Young noted in summer.

PLANTS—HUDSONIAN ZONE—Continued.

Townsendia parryi, Parry Townsendia. *A.*	*Chænactis alpina*, Alpine Chænactis.
Senecio fremonti, Paintbrush. *A.*	*Trisetum subspicatum*, Oat Grass.
Senecio crassulus, Paintbrush.	*Poa epilis*, Bluegrass. *A.*
Antennaria reflexa, Everlasting.	*Phleum alpinum*, Alpine Timothy. *C.*
Erigeron compositus, Fleabane. *C.*	*Carex nigricans*, Sedge.
Erigeron salsuginosus, Fleabane.	*Carex nova*, Sedge.
	Juncus subtriflorus, Rush.

ARCTIC-ALPINE ZONE.

The area above timberline on the highest mountains, the Arctic-Alpine Zone, corresponds in climate, and in plant species especially, to the barren grounds of the Arctic. It is not continuous from one range to another in Wyoming, for even in the mountainous northwest the areas are separated, often widely, by Canadian Zone valleys and forested divides of medium elevation.

A wide, almost unbroken stretch of this zone caps the massive Wind River Range for its entire length (Pl. XII, fig. 1), and there is a broken, irregular area of equal extent on the main crest and primary spurs of the rugged Absaroka Range (Pl. XII, fig. 2). The Gros Ventre Range is capped by a succession of Alpine plateaus sloping moderately toward the north, while the lofty peaks and jagged crests of the Tetons form a narrow strip of Alpine country. Broad Alpine areas on the Bighorn Mountains lie south of the gap at the head of Tongue River, and include all elevated summits of the Cloud Peak group. There are traces of the zone, too small for plotting on the map (see frontispiece), on a few mountains in the eastern and northwestern borders of Yellowstone Park. In southern Wyoming the Arctic-Alpine Zone is restricted to the lofty plateau on the Snowy Mountains, at the northern end of the Medicine Bow Range.

This high-altitude area is a bleak, wind-swept region of excessive snowfall in winter and frequent squalls of rain, sleet, or snow in the short summer, and arctic temperatures prevail throughout the year. On all the ranges snow fills the gulches and partly covers cold slopes and declivities even in the warmest months, while such massive, elevated ranges as the Wind Rivers, Absarokas, and Tetons carry extensive snow fields, and even a few perennial ice fields or glaciers in protected Alpine valleys.

The Arctic-Alpine Zone is conspicuously marked by the absence of tree growth, which ceases at its lower border. The altitude of timberline varies with latitude and slope exposure from 10,500 or 11,000 feet in the Sierra Madre and the Medicine Bow Range at the south, to 9,500 or 10,000 feet in the Bighorn Mountains and in the Yellowstone Park region.

Characteristic Species—Arctic-Alpine Zone.

The season of plant growth is from the middle of May until August, but during this brief period the bleak slopes and even the fields of slide rock for 1,500 or 2,000 feet above timberline are bedecked with a profusion of bright-hued Alpine flowers. A luxuriant growth of Alpine grasses and sedges obtains wherever there is any depth of soil, and furnishes rich pasturage for mountain sheep and a few other mammals which spend the summer in this usually forbidding region. In Wyoming plant growth rapidly decreases in size above 12,000 feet.

The low shrubby or matted growth usually extending from 500 to 1,000 feet above the limit of trees consists chiefly of dense thickets of willow (*Salix glaucops*) and copses of shrubby cinquefoil (*Dasiphora fruticosa*) which push up the bottoms and along the margins of wet gulches and basins; mats of mountain heath (*Phyllodoce empetriformis*) and alpine avens on rocky slopes and ridges; and spiny red currant (*Ribes montigenum*) and dwarfed raspberry (*Rubus strigosus*) in slide rock. Dwarf alpine willows mat the ground in places for an indefinite distance above timberline, and may even reach the highest summits with the mosses and lichens.

A large number of characteristic Arctic-Alpine herbaceous plants mark the zone in Wyoming, but only four species of breeding birds are peculiar to it, and no mammals.

Mammals—Arctic-Alpine Zone.

The few mammals found in the Arctic-Alpine Zone in Wyoming belong to lower zones. Among those attracted in summer to its grassy slopes and crests are the elk (*Cervus canadensis canadensis*), mountain sheep (*Ovis canadensis canadensis*), timberline chipmunk (*Eutamias oreocetes*), and Wind River mantled ground squirrel (*Callospermophilus l. caryi*). Marmots (*Marmota f. nosophora*), pocket gophers (*Thomomys uinta* and *T. f. fuscus*), meadow mice (*Microtus m. mordax*), coneys (*Ochotona uinta*), and rarely the Uinta spermophile (*Citellus armatus*), apparently are resident in the lower part of the zone in different localities. The coyote (*Canis lestes?*) and mountain red fox (*Vulpes macrourus*) range at various times into Alpine country in search of prey. On the Wyoming mountains mammals are rarely met with above 12,000 feet.

Breeding Birds—Arctic-Alpine Zone.

Lagopus leucurus leucurus,[1] White-tailed Ptarmigan.
Leucosticte australis,[1] Brown-capped Rosy Finch.
Leucosticte atrata,[2] Black Rosy Finch.
Anthus rubescens,[3] Pipit, Titlark.
Otocoris alpestris leucolæma,[4] Desert Horned Lark.

[1] On the Medicine Bow Range.
[2] On the Teton, Wind River, and Absaroka Ranges.
[3] Throughout the mountains.
[4] One of the few nesting birds of the Arctic-Alpine, but belonging chiefly to the Transition and Upper Sonoran Zones.

PLANTS ARCTIC-ALPINE ZONE.

[Species marked *H* occur also in the Hudsonian Zone.]

Salix petrophila, Rock Willow.
Salix tenera, Rock Willow.
Salix nivalis, Alpine Willow.
Salix saximontana, Creeping Willow. *H.*
Oxyria digyna, Mountain Sorrel. *H.*
Polygonum viriparum, Alpine Knotweed.
Claytonia megarrhiza, Arctic Spring Beauty.
Spraguea multiceps.
Silene acaulis, Stemless Catchfly. *H.*
Alsinopsis obtusiloba, Sandwort.
Paronychia pulvinata, Whitlowwort.
Ranunculus adoneus, Buttercup. *H.*
Thalictrum alpinum, Alpine Meadow Rue.
Arabis lyalli.
Smelowskia americana.
Draba cana, Whitlow Cress.
Draba crassifolia, Whitlow Cress.
Draba densifolia, Whitlow Cress.
Parrya nudicaulis, Purple Parrya.
Rhodiola integrifolia, Rosewort.
Saxifraga cernua, Arctic Saxifrage.
Leptasea flagellaris, Saxifrage.
Boykinia heucheriformis, Saxifrage, Boykinia. *H.*
Dryas octopetala, Alpine Avens.
Sibbaldia procumbens, Sibbaldia. *H.*
Sieversia turbinata, Mountain Avens. *H.*
Lupinus monticola, Mountain Lupine. *H.*
Aragallus nanus, Loco.
Aragallus lagopus, Loco.
Bupleurum americanum, Thoroughwax.
Orcoxis alpina.
Androsace carinata.
Gentiana romanzovi, Dwarf Closed Gentian.
Polemonium confertum, Jacob's Ladder. *H.*
Eritrichium argenteum, Alpine Forget-me-not.
Mertensia brevistyla and others.
Pedicularis parryi, Parry Lousewort. *H.*
Besseya alpina.
Campanula uniflora, Arctic Harebell.
Solidago decumbens, Goldenrod.
Erigeron pinnatisectus, Fleabane. *H.*
Erigeron radicatus, Fleabane. *H.*
Tonestus pygmæus.
Achillea alpicola, Alpine Yarrow.
Artemisia scopulorum, Alpine Sagebrush.
Festuca brachyphylla, Alpine Fescue.
Poa arctica, Arctic Bluegrass.
Poa lettermanni, Bluegrass.
Poa alpina, Alpine Bluegrass. *H.*
Carex engelmanni, Sedge.
Carex albo-nigra, Sedge.
Carex nubicola, Sedge.
Carex atrata, Black Sedge.
Carex phæocephala, Sedge.
Juncoides spicatum, Wood Rush. *H.*

IMPORTANCE OF BOREAL ZONES TO WYOMING AND ADJOINING AREAS.

Climatically and physically unsuited to agriculture, the high altitude Canadian,[1] Hudsonian, and Arctic-Alpine Zones nevertheless are not only a valuable but an essential complement to the lower agricultural areas of Wyoming and most adjoining States. As the chief sources of three great river systems—the Columbia, the Missouri, and the Colorado—their importance is far from local. The great value of the Boreal zones lies in their peculiar adaptation to moisture conservation. This is accomplished climatically on the bleak and barren Alpine slopes and summits, and by plant and forest cover and climate combined in the Hudsonian and Canadian Zones.

[1] See p. 42.

B13494

FIG. 1.—TETON RANGE, MOUNT MORAN SOUTH TO GRAND TETON.

Photograph taken from foot of Jackson Lake, June 5, 1911, by Edward A. Preble.

B13628

FIG. 2.—SNOW IN LOWER PART OF HUDSONIAN ZONE (10,800 FEET).

East slope of Bridger Peak, Sierra Madre, July 7, 1911.

B13671

FIG. 1.—HEAVY FOREST OF ENGELMANN SPRUCE, CANADIAN ZONE, WYOMING RANGE WEST OF MERNA (9,000 FEET).

B11788

FIG. 2.—RANK VEGETATION ON FLOOR OF CANADIAN ZONE FOREST, GRINNELL CREEK, ABSAROKA RANGE (7,500 FEET).

A heavy mantle of snow covers the entire Arctic-Alpine cap of the main ranges for seven or eight months of the year (Pl. XIII, fig. 1), while huge drifts and snow fields remain in protected spots throughout the summer. In the timberline region shaded gulches are banked with snow until August, and it is not uncommon to find snowdrifts in the forest depths of the Canadian Zone until midsummer (Pl. XIII, fig. 2), although most of the snow on the lower slopes goes off in flood in May and early June. The summer precipitation is heavy, consisting of rain in the forest belt, and frequent showers and squalls of rain, sleet, and snow on the peaks and higher slopes.

The rotting vegetation and mellow soil of the cool mountain forests are specially adapted to the retention of this moisture, much of which works down from the slowly melting snow banks in the Alpine area. The shaded, mossy forest floor soon becomes saturated, and the water, percolating through the leaves and loose soil, finds its way gradually through rock crevices into ravines and depressions, finally flowing clear and sparkling into the streams lower down. Thus is insured an abundance of pure mountain water to the arid but fertile valleys and plains, and, what is of greatest importance, a fairly uniform volume in the streams toward the end of the growing season, the period when most required by crops. The conversion through irrigation of portions of the valleys of the Snake, Yellowstone, Bighorn, Green, and North Platte Rivers in Wyoming, and especially in neighboring States, as well as of vast tracts as yet undeveloped, into rich agricultural districts is made possible through the combined agency of the climate and the forest and plant cover of the Boreal zones of Wyoming.

The Canadian Zone has large tracts of forest, mainly of lodgepole pine and Engelmann spruce (Pl. XIV, fig. 1), with considerable Douglas spruce on the lower slopes. While these are useful for lumber and other utilities, the intrinsic value is small in comparison with the permanent service they are naturally fitted to perform in connection with the agricultural utilization of the arid regions. Fortunately, most of the timberlands of the Canadian Zone in Wyoming are already included in national forests. Forest control with a view to their conservation is therefore most timely.

While the higher mountain slopes of Wyoming afford a rich pasturage during the summer months for many hundreds of thousands of sheep, careful regulation of sheep grazing is of the utmost importance, as the natural plant cover is a vital factor in catching and holding moisture. (Pl. XIV, fig. 2.) Once this is badly broken up or removed by overgrazing the rains go off with a rush, carrying much of the soil with them. This results in dry, barren slopes, dirty streams, and a greatly diminished flow of water in the lower country during much of the growing season, unless there are adequate water-

storage facilities. Mountains which have been extensively grazed include the Wyoming and Salt River Ranges, the southern end of the Wind River Range below the Big Sandy, Sierra Madre, and the mountains on either side of the Bighorn Basin at its southern end. The mountain meadows and parks with their luxuriant grasses constitute an ideal summer range for cattle, and are extensively utilized for this purpose.

Wyoming offers many attractive regions to the tourist, the sportsman, and to those in search of health or recreation. As a permanent pleasure ground the mountainous region at the northwest is a valuable asset, and is perhaps unsurpassed in extent and rugged grandeur. Dashing trout-filled streams add to the attractiveness of a section full of wild charm and beauty, while the dense forests of Yellowstone Park and the northern end of Jackson Hole afford a safe retreat and breeding range, under Federal and State protection, for many thousands of elk and other large game animals, and insure the best of hunting in season in districts adjacent to these protected areas.

NOTES ON THE DISTRIBUTION OF CONSPICUOUS TREES AND SHRUBS OF WYOMING.

The following annotated list of Wyoming trees and shrubs, while very incomplete, includes principally the more conspicuous and characteristic zone species, and should add to the knowledge of their distribution within the State. It is based chiefly on notes and specimens collected by Biological Survey field parties.

Pinus albicaulis Engelmann. White-Barked Pine. (Fig. 3.)

The small white-barked pine in Wyoming is peculiar to the high altitudes of the northwest, where it is a characteristic tree of the Hudsonian Zone just below timberline. It occurs on all the lofty mountains, finding its southern limits in the main chain of the Rockies on the Wind River and Salt River Ranges. At timberline it is often the most abundant tree, especially on parts of the Absaroka Range, but usually shares this bleak region with dwarfed alpine firs and Engelmann spruces, pushing up dry slopes and crests of exposed ridges in ascending tongues, while the spruces and firs occupy wet gulches and the deeper-soiled slopes.

B11788

FIG. 3.—Forest of white-barked pine (*Pinus albicaulis*) just below timberline on west slope of Whirlwind Peak, Absaroka Range (9,800 feet).

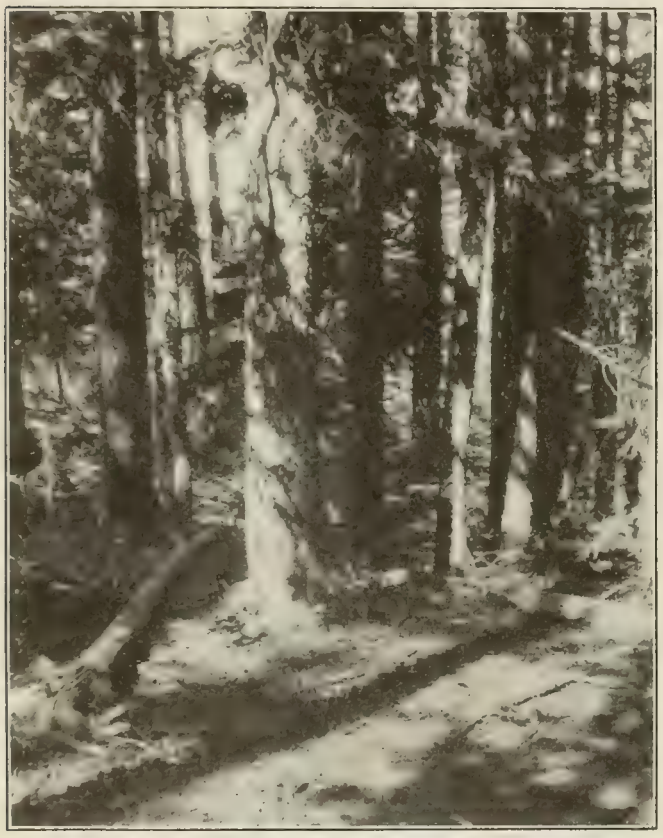
Pinus flexilis James. Rocky Mountain White Pine.

The Rocky Mountain white pine has a general dispersion in upper Transition and Canadian Zones in all except the northeast corner of the State. It has its center of abundance with the Douglas spruce along the lower edge of the Canadian forest belt, occupying the ridges and dry slopes, while the spruces are in gulches and on steep, cold exposures. There are few gravel or rocky ridges on the high central and western plains and deserts that do not have more or less of this pine in scattered and usually somewhat ragged growth. In Wyoming it is a small tree, rarely attaining a height of more than 30 or 40 feet or a diameter above 1½ feet under most favorable conditions. Its usual

habit of growth is scattering and patchy, but in deep-soiled mountain districts it often produces groves of considerable extent.

Pinus scopulorum (Engelmann) Lemmon. Rocky Mountain Yellow Pine.

The distribution in Wyoming of the Rocky Mountain yellow pine, a well-known Transition Zone tree, is mainly west to the eastern slopes of the Bighorn Mountains and the region of the upper Platte, as follows: Black Hills, heavy open forest to 6,000 or 6,500 feet altitude; Bear Lodge Mountains, moderate growth with oaks, 3,500 to 6,000 feet; Colony, low ridges; throughout the borders of Cheyenne River drainage, in scattering pockets and fringe; watersheds between Belle Fourche and Tongue Rivers, in thin forest over roughest sections; lower eastern slopes of Bighorn Mountains, tolerably wide belt up to 6,000 or 7,000 feet; foothill region of Casper Mountains south throughout the length of the Laramies, including the Hartville group east of the Platte, in usually good growth; divide southeast of Efell; Pine Mountain south of Natrona; borders of North Platte Valley, between Alcova and Leo, and along north base of Shirley Mountains, scattering trees; Seminole Canyon on the Platte, heavier growth; Rock River, ridges; Woods, Medicine Bow Range, some at lower edge of coniferous forest; basal slopes of Sierra Madre south of Downington; and canyons near the mouth of Grand Encampment River. This pine was not found in western Wyoming, although doubtless there are scattering trees on the basal slopes of some ranges.



B11660M

FIG. 4.—Forest of Engelmann spruce (*Picea engelmanni*) on north slope of Ferris Mountains (9,000 feet).

The yellow pine yields valuable lumber mainly in the Black Hills, Bear Lodge and Bighorn Mountains, and on the Laramies in the region north of Laramie Peak. Elsewhere its growth is generally more or less scrubby.

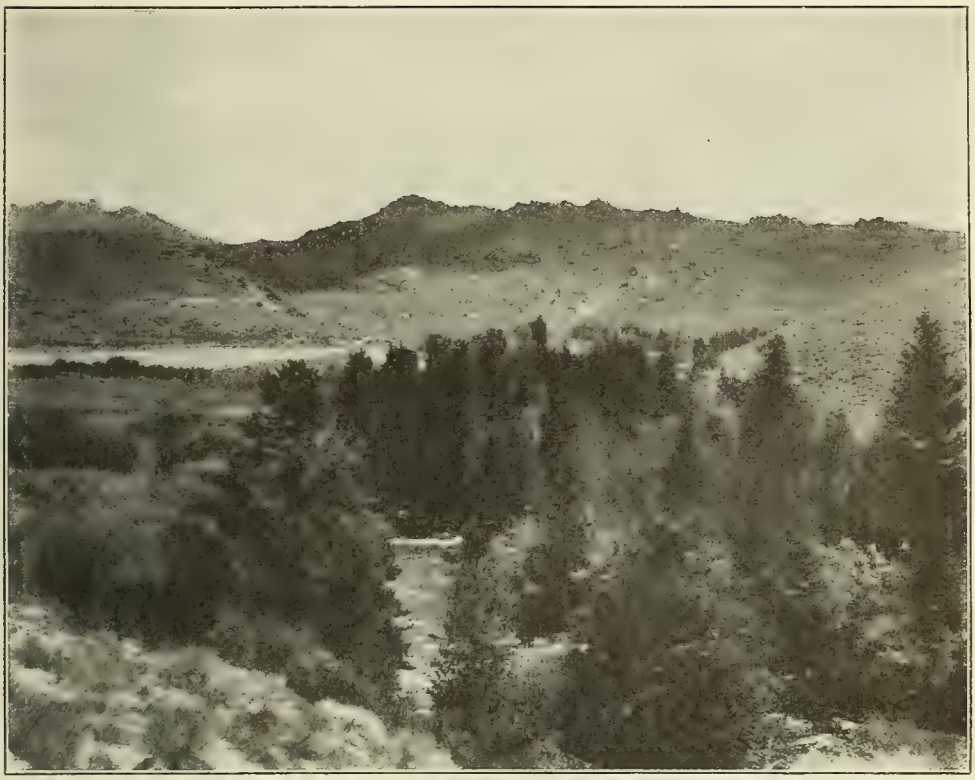
Pinus murrayana Balfour. Lodgepole Pine.

The coniferous element of the Canadian forest belt in Wyoming is chiefly of lodgepole pine and Engelmann spruce. The pines, although occurring throughout the full width of the Canadian Zone, reach their greatest abundance and heaviest and purest stand in its lower half. The best forests are on the main ranges, varying in elevation from 8,500 to 10,000 feet on the Sierra Madre at the south; 8,000 to 9,500 feet on the Wind River Range; and 7,000 to 9,000 feet in Yellowstone Park, the northern Absarokas, and on the eastern slopes of the Bighorns.

The lodgepole pine forests of Wyoming are of great value, but have been extensively levied upon for ranch fences, railroad ties, mine lagging, and lumber, and extensive tracts have been destroyed by fire. The deforested areas are now largely grown up with second-growth pine and aspen.

Pinus edulis Engelmann. Pinyon; Nut Pine.

The pinyon, a small representative of the Upper Sonoran Zone, barely enters Wyoming in the lower valley of Green River. Scattering trees were found at 7,000 feet elevation on the north face of a juniper ridge 3 miles north of the Utah boundary and the same distance east of Green River. The pinyon may possibly occur elsewhere in this rough juniper-clad ridge and



B13664

FIG. 5.—Fringe of blue spruce (*Picea parryana*) on the Big Sandy, southwest base of Wind River Range (7,500 feet).

mesa country, but it was not detected from Green River east to Red Creek, and thence north to Rock Springs.

Picea engelmanni (Parry) Engelmann. Engelmann Spruce. (Fig. 4.)

The Engelmann spruce is the principal conifer in the upper part of the Boreal forest belt on the high ranges of northwest Wyoming, and also on the Bighorn, Sierra Madre, and Medicine Bow Ranges. Next to the lodgepole pine it is the most abundant forest tree of Yellowstone Park. Although of regular occurrence at timberline in a dwarfed state, this spruce belongs to the Canadian Zone, attaining its maximum growth on cold, damp slopes and in bogs between 8,000 and 9,000 feet. It does not attain its best development in dry situations or on warm slopes, where it is found at a somewhat higher level.

Picea parryana (Andree) Sargent. Blue Spruce. (Fig. 5.)

The blue spruce occurs chiefly in western Wyoming north to Jackson Lake and the head of Wind River, but was also noted at Woods and in gulches south

of Sherman, and should be present elsewhere in the southern mountains. It inhabits the margins of cold streams in the lower border of the Canadian forest belt between 7,000 and 8,000 feet elevation (6,500 to 7,500 feet in Jackson Hole), forming usually a most attractive fringe of scattering symmetrical trees.

Abies lasiocarpa (Hooker) Nuttall. Alpine Fir.

The alpine fir has much the same distribution and vertical range as the Engelmann spruce, although generally less abundant and growing in scattered thicket formation, rarely forming a heavy forest. With the spruce it extends regularly to timberline on the Wyoming ranges, where it is the more common of the two and forms dense prostrate mats on the bleak, wind-swept slopes. This fir is partial to cold gulches, stream banks, and damp spots generally. It may be seen to best advantage in typical growth as dark scattered clumps in aspen woods. While usually a small tree, it attains large size in gulches and on streams in the higher portions of Yellowstone Park, where it forms forests of considerable extent above 8,000 feet altitude. It was observed on all the mountains except the Bear Lodge and Black Hills groups at the northeast.

B11691

FIG. 6.—Forest of Douglas spruce (*Pseudotsuga mucronata*), north slope of Ferris Mountains (8,500 feet).

Abies (concolor?) Lindley. White Fir.

The white fir (apparently *Abies concolor*) forms small forests below 9,000 feet elevation on the northern shoulders of the Uinta Mountains west of Lonetree, and is present also in fairly good stand with aspens on the summit of the plateau west of Maxon. Firs which were common at 8,000 feet on the western slopes of the Salt River Range near Afton also had smooth, dark-gray bark and were unquestionably distinct from the light-barked *A. lasiocarpa* on the upper slopes of the same mountains above 9,000 feet. Unfortunately no specimens were preserved from the above localities.

Pseudotsuga mucronata (Rafinesque) Sudworth. Douglas Spruce. (Fig. 6.)

The Douglas spruce has a wide distribution in upper Transition and lower Canadian Zones from the Laramie and Bighorn Mountains westward. It was not observed on the Black Hills or Bear Lodge Mountains. This spruce grows chiefly at the lower edge of the lodgepole pine belt on the main ranges of

western Wyoming, reaching down to open sagebrush slopes on their basal flanks, and on the Bighorns and Laramies, extending down into the upper part of the yellow pine belt. It varies locally as to abundance from a thin fringe of scattering trees and thickets on cool declivities and in gulches (which is usual), to a wide belt of heavy pure forest of lumber size.

Juniperus scopulorum Sargent. Rocky Mountain Juniper.

The most conspicuous and widely distributed juniper in the State is the Rocky Mountain juniper, occurring from the barren rocky ridges, canyons, gulches, and badlands bluffs on the Sonoran plains and deserts, up through the Transition Zone, where it mingles with yellow pines, Douglas spruces, and Rocky Mountain white pines on the lower mountain slopes. This juniper is of scattering growth along the bases of mountains and on the margins of the desert basins and valleys, and does not form a well-defined belt along the upper edge of the Upper Sonoran Zone as it often does in the southern Rocky Mountains.

Juniperus knighti A. Nelson. Desert Juniper.

The distribution of the desert juniper is imperfectly known, owing to very scattering field work in the difficult Red Desert region which it inhabits. The few localities from which there are specimens indicate a restricted range, mainly in the Upper Sonoran Zone. S. G. Jewett collected the species at Mountainview, on May 27, 1913, and it appears to be the dominant juniper at Rock Springs, near Carter, and in the badlands to the south and east of Lyman. On the Green River bluffs near the Utah boundary *Juniperus monosperma* is not uncommon, and on the higher borders of the Red Desert *J. scopulorum* is the common species. The desert juniper is usually of shrubby stature, branching from the base, and scarcely attains the dignity of a tree. Nelson found the species on the sandstone bluffs of the Bitter Creek drainage, and records specimens from Point of Rocks and Rock Springs.[1]

Juniperus monosperma Engelmann. One-Seeded Juniper.

The one-seeded juniper is found at the northern base of Owl Creek Mountains west and southwest of Thermopolis; at Hailey, southeast of Lander; along the Platte near Alcova in canyons and on dry slopes up to 6,300 feet elevation; and on the rough breaks along the lower Green River Valley, particularly on the east side between Sage Creek and the Utah boundary. It is tolerably common on the Snake River bluffs near Baggs and is probably the species which forms a considerable belt along the western bases of the Sierra Madre. It was noted only in the Upper Sonoran Zone, extending up to 7,500 feet on the hot slopes east of Green River near the State line.

Juniperus sibirica Burgsdorff. Low Juniper.

The low juniper, a graceful evergreen, is a characteristic undershrub in the Boreal forest belt throughout the Wyoming mountains. On most of the loftier ranges it extends to timberline, where it forms dense prostrate mats among rocks. Its center of abundance is in the Engelmann spruce and lodgepole pine forests of the Canadian Zone.

Juniperus communis Linnæus. Mountain Juniper.

Not infrequent in mountain forests at lower elevations than the low juniper. The shrubby mountain juniper was noted as follows: Foothills west of Wheatland, 5,500 feet; Springhill; near Sundance; Wolf, north base of Bighorn Mountains, 6,700 feet; head of Pat O'Hara Creek, northwest of Cody.

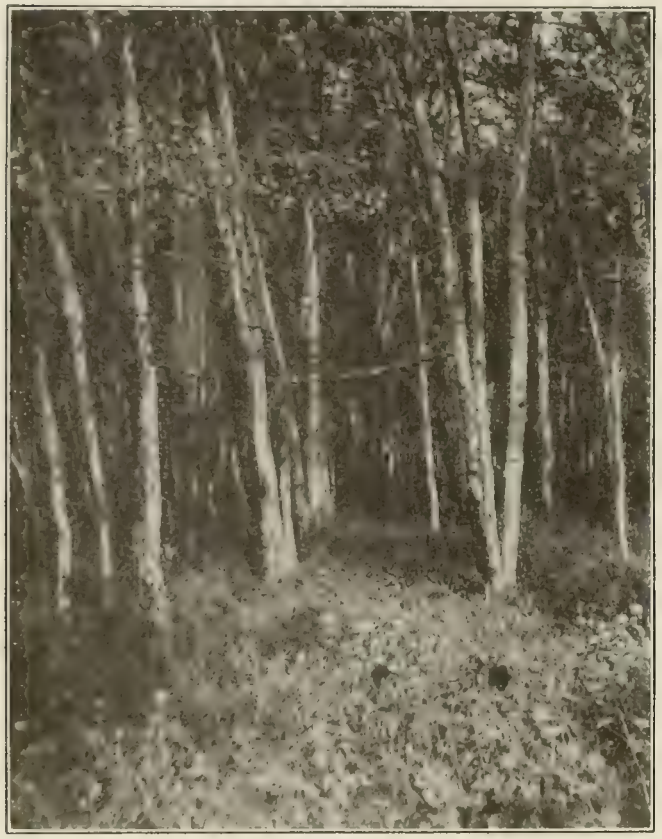
[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 54, 1898.

Juniperus sabina Linnæus. Creeping Juniper; Trailing Savin.

Mats of the creeping juniper, or trailing savin, are conspicuous on dry gravel ridges and exposed points and summits of high hills along the northern edge of Wyoming between the Bighorn and Bear Lodge Mountains. The species extends west at least to the eastern base of the Absaroka Range, but is of more general distribution in the northeast. It was not found in other sections of the State. The habitat of this species is in the Transition and lower Canadian Zones.

Populus tremuloides Michaux. Aspen Poplar. (Fig. 7.)

The Boreal aspen poplar is generally dispersed at suitable elevations, but does not, as a rule, reach large size in the Wyoming mountains. It commonly occurs in thickets 10 to 20 feet high on damp, cold slopes, as undergrowth in the coniferous forests, or as first growth on burned-over tracts. Low, scraggy thickets of aspen are on most of the cold slopes and draws above 7,500 feet altitude on barren elevations of the southwest, as the Aspen Mountains, Bear River Divide, and the high plateaus east of Green River near the southern boundary of the State. Beautiful aspen groves were noted, however, between 8,000 and 9,000 feet on the lower southern slopes of the Wind River Range east of Leckie, on the divide between Hoback and Green Rivers, and on the northern shoulders of the Uinta Mountains southeast of Hilliard. The aspen is perhaps the best characterizing tree of the Canadian Zone.



B11622

FIG. 7.—Grove of aspen poplar (*Populus tremuloides*) near Springhill, north base of Laramie Peak (6,000 feet).

Populus balsamifera Linnæus. Balsam Poplar.

The balsam poplar inhabits the borders of many of the larger streams in the northwestern mountains, being largely confined to the Canadian Zone between 6,500 and 7,500 feet elevation. It occurs south in the Jackson Hole country at least to the Gros Ventre River. Scattering trees are found also in wet gulches at the southern base of the Bear Lodge Mountains near Sundance at about 5,000 feet elevation.

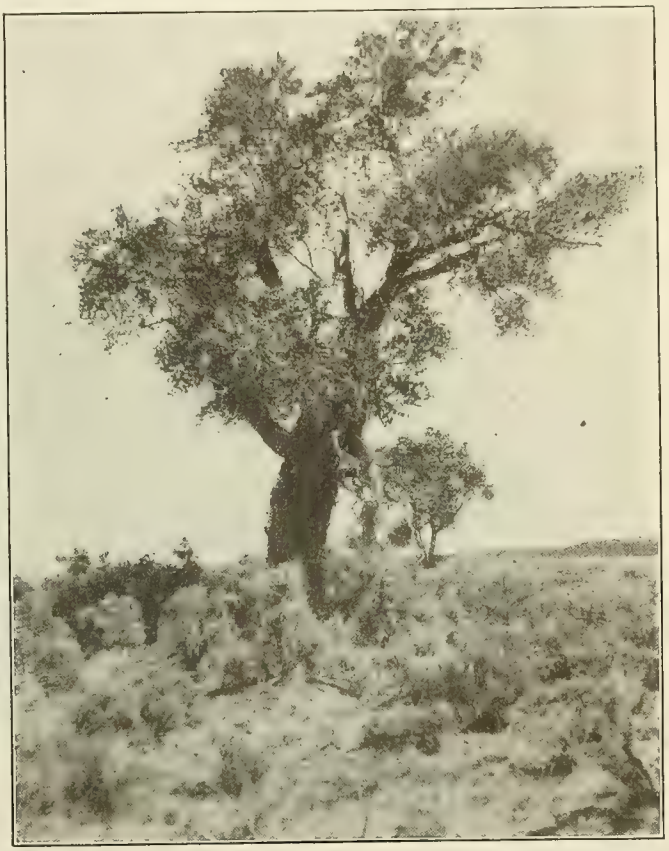
Populus occidentalis (Rydberg) Britton. Broad-Leaved Cottonwood.

The broad-leaved cottonwood, characteristic of the Upper Sonoran Zone, forms the principal fringe on the streams of eastern and northern Wyoming,

attaining perfection of growth in the lowest and warmest valleys. Large groves border the Bighorn, Belle Fourche, and especially the streams of the lower Platte drainage. There is a great deal of cottonwood growth on the Cheyenne River and other streams southwest of the Black Hills, but in this section the species grows in a very stunted state, low and irregular and very thick at the the base. In the Wheatland district it occurs in places in heavy growth with *Populus acuminata*, and along the base of the mountains generally meets and commingles with the narrow-leaved Transition species, *P. angustifolia*.

Populus acuminata Rydberg. Lance-Leaved Cottonwood.

On the Chugwater, Sibylee, and other tributary streams of the Laramie and North Platte Rivers east of the mountains the lance-leaved cottonwood forms in many places a heavy fringe with *Populus occidentalis*, though by no means so generally distributed as the latter species. A splendid growth of the lance-leaved cottonwood is on Sibylee Creek southwest of Wheatland. The species was not noted in northern Wyoming, but at the west scattering trees are on Green River, just north of the Utah line.



B11692

FIG. 8.—Large narrow-leaved cottonwood (*Populus angustifolia*) on sage flat in upper Wind River Valley.

Populus angustifolia James. Narrow-Leaved Cottonwood. (Fig. 8.)

The narrow-leaved cottonwood inhabits the borders of mountain streams in the Transition Zone, mainly at elevations from 6,000 to 7,500 feet at the west, extending down to 5,000 feet in the central districts, and to 4,500 feet at the eastern base of the Bighorn Mountains. It is apparently absent from the northeastern part of the State. Important streams bordered with good growth include the Bear, Green, Wind, and Greybull Rivers, the north and south branches of the Shoshone River above the forks, Snake River below the mouth of the Gros Ventre, and the upper North Platte down to 18 miles above Casper. Unusually fine groves are on Wolf and Big Goose Creeks, at the eastern base of the Bighorns.

Salix amygdaloides Anderson. Peach-Leaved Willow.

The large peach-leaved willow occurs in scattered clumps along streams in the Upper Sonoran Zone, chiefly at the east and north, as follows: Chugwater Creek and affluents; Little Bear Creek northeast of Meadow; Sibylee Creek west of Wheatland; Rawhide Creek to base of Rawhide Butte; near Lusk; Hay

Creek east of Aladdin; Wind Creek northeast of Moorcroft; Sheridan; Arvada; Clear Creek, Clearmont to Buffalo; Bighorn River and tributaries near Thermopolis; and Green River near Utah boundary.

Salix bebbiana Sargent. Bebb Willow.

The Bebb willow is characteristic on foothill and lower mountain slopes up to about 9,000 feet altitude, and there are few if any ranges in Wyoming where it is not present. The usual growth is in scattered clumps about springs and bogs, but occasionally there is a heavier stand on the margins of mountain streams. The height attained seldom exceeds 12 or 15 feet, and 8 or 10 feet is usual. Specimens were taken on the Laramie, Bear Lodge, Bighorn, and Wy-

B11749

FIG. 9.—Terraced copses of gray-leaved willow (*Salix glaucops*) at timberline, Needle Mountain, Absaroka Range.

oming Ranges, and at Evanston, while it was observed at a wide range of localities. Nelson records it from Creston, on the open Red Desert.[1]

Salix pyrifolia obscura Anderson. Willow.

Another willow, *Salix pyrifolia obscura*, was collected in the upper forests on the Wyoming Range west of Merna, between 9,000 and 10,000 feet altitude, in the Canadian Zone. It is tolerably common at this locality.

Salix nelsoni Ball. Nelson Willow.

Vernon Bailey collected the Nelson willow along the Hudsonian crest of the Salt River Range at 10,000 feet elevation, August 20, 1911.

Salix glaucops Anderson. Gray-Leaved Willow. (Fig. 9; Pl. XI, fig. 2.)

The gray-leaved willow is a low species of Alpine bogs, growing in dense copses about 2 feet high near timberline on the Bighorn, Wind River, and

[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 59, 1898.

Absaroka Ranges, and doubtless elsewhere. On Whiskey Mountain, south of Dubois, a few blossoms were out on May 14, 1910, but the leaves had not unfolded. The species was not in leaf by June 5 at timberline on the Bighorn above Hyattville. It was very abundant on Needle Mountain, Absaroka Range, in beautiful terraced copse formation, and likewise on the Wind River Mountains south of Fremont Peak.

Salix petrophila Rydberg. Rock Willow.

The rock willow was collected on the Alpine slopes above timberline at the head of Bull Creek, Wind River Range, in August, 1893, by Vernon Bailey.

Salix tenera Anderson. Alpine Rock Willow.

Low dense mats of the Alpine rock willow, which is very abundant on Whirlwind Peak, in the Absaroka Range, cover portions of these slopes between 10,000 and 11,000 feet elevation.

Salix nivalis Hooker. Alpine Willow.

The dwarf alpine willow is tolerably common on the bleak slopes above timberline on the Wind River Range, occurring among the rocks in dense creeping mats a few inches high. It is abundant south of Fremont Peak from 11,500 feet upward.

Salix saximontana Rydberg. Net-Veined Willow.

More generally dispersed on the Wyoming ranges than the other Alpine willows, but similar in habit of growth, *Salix saximontana* occasionally extends a little below timberline. It is especially abundant at the northern end of the Teton Range, where the creeping mats are very extensive, and push down the cool Hudsonian slopes to 9,500 feet altitude.

Ostrya virginiana (Miller) Willdenow. Ironwood.

Vernon Bailey reports the ironwood as abundant in Sand Creek canyon above Beulah, at the northern base of the Black Hills. The species closely approaches the Wyoming boundary in northwestern Nebraska, 8 or 10 miles east of Kirtley, Wyo., where it is not infrequent in wooded canyons along the northern escarpment of Pine Ridge.

Corylus rostrata Aiton. Beaked Hazelnut.

The beaked hazelnut is abundant on the upper slopes of the Bear Lodge Mountains and Black Hills, forming dense undergrowth in aspen and birch thickets between 5,500 and 6,000 feet altitude. It appears to be absent from the main ranges in Wyoming.

Betula papyrifera Marshall. Canoe Birch. (Fig. 10.)

The canoe birch apparently reaches its southern limits on the Bear Lodge Mountains and northern Black Hills. Over this region it grows to medium size, and with the aspen occurs in dense thickets on cool, shaded slopes and in damp spots as low as 5,000 feet altitude, and on Sundance Creek scattering trees of good size are found at 4,700 feet. On the dry upper slopes of the Bear Lodge Mountains this birch becomes very scrubby. It is apparently absent from the Bighorn Mountains and the ranges of western Wyoming.

Betula fontinalis Sargent. Rocky Mountain Birch. (Fig. 11.)

The Rocky Mountain, or black, birch borders often in dense growth most of the streams on the basal slopes of the mountains, and under the cooling influence of the mountain water extends some distance out onto the plains. At the base of the Bear Lodge Mountains it is common at 4,000 feet altitude, but farther

west it is usually present between 6,000 and 7,500 feet. On warm exposed slopes of the Wind River Range north of Big Sandy it extends to 8,000 feet.

Betula glandulosa Michaux. Dwarf Birch.

The dwarf birch was noted only in the mountain valleys of the northwest, from Yellowstone Park (West Gallatin and Lewis River meadows) south to the Wyoming Range (South Piney canyon at 7,500 feet altitude), in the Canadian Zone. This little birch is especially abundant in the extensive willow bogs and swamps bordering Jackson Lake, where it occurs in dense thickets 3 or 4 feet high. Its leaves had mostly turned to a deep Indian red and a few were falling in Jackson Hole by September 13, 1910. It was noted also as follows: Head of Pacific Creek, near Two Ocean Pass; and Horse Creek meadows, at Merna, 8,000 to 9,000 feet.

B14338

FIG. 10.—Thicket of canoe birch (*Betula papyrifera*) in gulch near Sundance, Bear Lodge Mountains.

Alnus tenuifolia Nuttall. Alder. (Fig. 12.)

The alder is found in a growth of varying density on the upper reaches of cold mountain streams, and with many other Canadian Zone species follows the cold conditions on their margins down for some distance into the Transition Zone. It is most abundant in the mountainous northwest, and was not noted in the Bear Lodge Mountains or on the northern groups of the Laramie Range.

Ulmus americana Linnæus. Elm.

The elm penetrates Wyoming for a short distance in the low valleys at the northeast. It was common and growing to large size on Sand Creek to 10 miles above Beulah at the northern base of the Black Hills, and on Hay Creek west to Aladdin and Eothen, while it is reported at Hulett in the Belle Fourche Valley. Vernon Bailey found it on Little Powder River near Morse.

Quercus macrocarpa Michaux. Bur Oak.

The bur oak extends into Wyoming from the northeast and is found in abundance over a small area in Crook County, principally east of the Belle Fourche River and north of Linden and Inyankara. It occurs in scattered groves on the partially open basal flanks of the Bear Lodge Mountains and at the northern base of the Black Hills, extending to the dry Bear Lodge summits at 6,000 feet elevation, where Vernon Bailey found scrubby thickets 4 or 5 feet

high, loaded with acorns, in August, 1913. In some of the stream valleys the bur oak grows to large lumber size, notably on Sand Creek above Beulah, and many trees were there noted with clean straight trunks of good height from 3 to 4 feet in diameter at the base. The vertical range of this oak is about the same as that of the yellow pine, with which it usually commingles in this region. Vernon Bailey noted a little oak growth near the head of the Little Missouri River, apparently its western limit in the State.

Atriplex canescens James. Saltbush; Gray Shadscale.

The various saltbushes are characteristic Sonoran species of the arid Great Basin region, and barely enter the Great Plains area on some of the dry valley

B11637

FIG. 11.—Clumps of Rocky Mountain birch (*Betula fontinalis*) 15 feet high, at north base of Shirley Mountains.

flats at the eastern base of the foothills. They are mostly alkali-resistant and, with the possible exception of *Atriplex canescens*, furnish valuable winter forage for sheep in the central desert sections. Of the three principal shrubby species found in Wyoming, *A. canescens* is the least abundant. It is apparently absent from the Red Desert proper where *A. confertifolia* and *A. nuttalli* abound, but extends farther to the east than either of the foregoing. *Atriplex canescens* occurs in very dense growth 3 feet or more high on dry flats along the Chugwater at Bordeaux, and also in the sand along the Laramie at Uva, but is in scattering growth elsewhere.

Atriplex confertifolia S. Watson. Round-Leaved Saltbush.

The round-leaved saltbush is a low stocky shrub 1 or 2 feet high, very abundant on sandy and alkaline soils up to 7,500 feet elevation on warm slopes east of Green River near the Utah line; bad lands south of Lyman, to 7,000 feet;

Bear River below Evanston, to 6,600 feet; Fossil; Bigpiney; Dubois; Trout Creek, north Shoshone Valley; Bighorn slopes above Hyattville, to 5,500 feet; north base of Rattlesnake Mountains, to 6,500 feet; Splitrock, Sweetwater Valley; east to Fort Steele, Shirley, Old Fort Fetterman, and Arvada.

Atriplex nuttalli S. Watson. Nuttall Saltbush. (Pl. IV, fig. 2.)

The Nuttall saltbush, a low-spreading species, commonly known as "salt sage" to the sheepmen, is of great economic value, as it affords the chief winter food to the flocks on the Red Desert. It has about the same range as *Atriplex confertifolia*, but is seldom found in sand, being partial to dry adobe and saline flats, where it forms often the dominant plant growth. Extensive flats at Frannie and elsewhere in the Bighorn Basin are covered with a pure and uniform growth of this saltbush. The observed eastern limits are Walcott; Little Medicine Bow River west of Marshall; Indian Creek at State line north of Kirtley; Newcastle; and Colony.

B11629

FIG. 12.—Fringe of alder (*Alnus tenuifolia*) on Pacific Creek below Two Ocean Pass.

Grayia spinosa Moquin. Grayia.

A characteristic spiny shrub of the Sonoran desert tracts from the Sweetwater Valley westward, especially abundant in sandy or adobe soils at the lowest levels. On the sandy hummocks between Frannie and Garland at the end of June dense clusters of flat, winged seeds were borne in great profusion on the grayia bushes. These varied from greenish to pink or purple-brown and lent a peculiar hue to the landscape. This shrub has considerable forage value, as its thick leaves and seeds, gathered into drift piles under the bushes, are eagerly eaten by sheep in winter.

Grayia spinosa was common from Independence to Splitrock; Dry Lake to Lorey; on first and second benches above the Platte at Fort Steele; Worland; Manderson; Bonanza; Greybull west nearly to Cody; Rock Springs region; Green River near Utah line; Carter to Lyman; bad lands south of Lyman; Cumberland; Fontenelle to Opal; and Green River flats north nearly to Labarge.

Sarcobatus vermiculatus Torrey. Greasewood. (Pl. IV, fig. 1.)

This common desert shrub is of wide dispersion in the more arid portions of the Upper Sonoran Zone and was noted at numerous localities. It

forms a very rank growth on the dry alkaline lake basins and flats of central Wyoming, especially in the Red Desert region, where its dark-green foliage and large size make it the most conspicuous of the alkali-resistant shrubs. The greasewood follows dry adobe valley flats to about 7,000 feet elevation.

Berberis aquifolium Pursh. Barberry; Oregon Grape.

The Oregon grape, a low undershrub, is characteristic of dry forested or partly wooded slopes throughout the State, mainly in the Transition Zone. It is commonly associated with the bearberry, with which it penetrates to the lower edge of the Canadian forest belt. On the Ferris Mountains it was noted at 8,700 feet altitude, and on the west side of the Salt River Range was common to 9,000 feet.

Ribes longiflorum Nuttall. Flowering Currant.

In early summer the brush fringe along streams at the lower elevations is enlivened by the yellow bloom of the flowering currant. This shrub is a characteristic Sonoran species, but is perhaps most conspicuous at the base of the mountains, where it penetrates the foothills for some distance in warm stream valleys. Its upper limits were observed as follows: Foothills west of Wheatland, to 5,300 feet altitude; eastern base of Bighorn Mountains; Greybull River at Meeteetse; Pat O'Hara Creek to 6,000 feet; south slope of Owl Creek Mountains to 7,000 feet; Bull Creek, Wind River Valley; streams of Salt River Valley; Evanston and west slope of Bear River Divide to 7,500 feet; Mountainview; and Henry's Fork of Green River to Burntfork P. O.

Ribes inebrians Lindley. Red Currant.

The red currant is widely distributed in the Transition Zone over most of Wyoming, extending regularly to the lower edge of the Canadian Zone. Flowering specimens were taken in the Laramie foothills west of Islay on June 16, 1909, and near Merna, Wyoming Range, at 8,000 feet altitude, as late as August 10, 1911. This species is partial to rocky situations.

Ribes montigenum McClatchie. Bristly Red Currant.

A high-altitude species, the bristly red currant has a general distribution on the higher Wyoming ranges. It is most abundant near timberline, where it occurs either as scattering bushes in slide rock, or in dense patches a foot or two high on deep-soiled slopes, as on the Wyoming Range west of Merna. It was in flower on the summit of Bridger Peak in the Sierra Madre, on July 7, 1911, and still so on the high Wind River Range south of Fremont Peak on July 18. The red, edible fruit was abundant and fully ripe in the timberline region on the Teton Range on August 30, 1910. It was found in abundance on the high ridge extending north from Needle Mountain, in the Absaroka Range, between 10,000 and 11,000 feet elevation; and also on the Salt River Range, above 9,000 feet.

Ribes lacustre (Persoon) Poiret.

This species occurs in Canadian Zone forests in northwestern Wyoming. It was still in flower near the upper end of Fremont Lake on July 15, 1911, but was bearing fruit on Grinnell Creek, Absaroka Range (8,000 feet altitude), July 30, 1910. Specimens were collected at both localities.

Ribes petiolare Douglas. Mountain Black Currant.

The mountain black currant, a wide-ranging Boreal species, was collected on the summit of the Bear Lodge Mountains on June 20, 1912, where it was not uncommon on the dry crests at 6,000 feet elevation. Flowering specimens were

also taken in the Canadian Zone forest near the upper end of Fremont Lake, Wind River Range, July 15, 1911, and fruiting specimens at Tower Falls, Yellowstone Park, August 11, 1910. It is especially abundant in the Yellowstone Park forests.

Ribes viscosissimum Pursh. Currant.

This currant is characteristic of the Canadian Zone forest belt in northern Wyoming. Flowering specimens were taken at 8,500 feet elevation on the head of Shell Creek, Bighorn Mountains, June 5, 1910; near the upper end of Fremont Lake, Wind River Range, July 15, 1911; and at 8,000 feet on Grinnell Creek, Absaroka Range, as late as July 30, 1910. Vernon Bailey collected the species on Wolf Creek, northern slope of the Bighorns, August 10, 1913.

Edwinia americana (Torrey and Gray) Heller. Edwinia.

The low flowering edwinia was found only on the crest of the Laramie Range east of Laramie, between 8,500 and 9,000 feet elevation. Its handsome white cymous bloom enlivened the rock ledges and cliffs on June 18, 1909.

Cercocarpus ledifolius Nuttall. Mountain Mahogany.

The mountain mahogany is a small evergreen tree or stout shrub peculiar to rocky plateaus and ridges and warm exposed basal slopes of mountains. In Wyoming a scattering distribution is indicated from the lower Green River Valley north to Jackson Hole, in the Transition Zone. Most of the rocky ridges adjacent to Green River near the Utah boundary are clothed up to 7,500 feet elevation with dense scrubby thickets from 3 to 6 feet in height. The species was not found farther north in the Green River country, but enters the State from the west along Snake River, and covers in good growth the more exposed of the lower western slopes of the Salt River Range east of Afton and Smoot up to 7,500 feet. Its upper limits in the Snake River drainage are reached apparently near Jackson, where Edward A. Preble found a considerable growth on a warm slope at 7,000 feet in a tributary gulch of Cache Creek.

Cercocarpus intricatus Watson. Mountain Mahogany. (Pl. XV, figs. 1 and 2.)

An abundant evergreen shrub on warm open slopes of the Bighorn Mountains. On the eastern side scattering bushes dot the bare Tongue River bluffs at Ranchester. The species forms dense thickets 3 feet high at about 5,000 feet altitude near Eaton's Ranch, and thence it ascends dry, rocky ridges to 6,500 feet on bare exposed points in the mountains south of Wolf. On the warm western side of the Bighorns above Hyattville *Cercocarpus intricatus* was not seen below 5,800 feet, but between 6,000 and 6,500 feet the dry, hot, reddish slopes were dotted with this intricately branched, steely gray shrub.

Cercocarpus parvifolius Nuttall. Mountain Mahogany. (Pl. II, fig. 1.)

This mountain mahogany occurs mainly in the Transition Zone in Wyoming, although in the southern Rocky Mountains its center of abundance is in the juniper and pinyon belt of the Upper Sonoran Zone. It is partial to warm, rocky situations, either partly open foothill slopes or outlying ridges and buttes on adjacent plains or deserts. The largest growth of mountain mahogany observed was fully 9 feet high, on the pine-clad foothills southwest of Wheatland, at 5,300 feet altitude. The usual height attained is from 4 to 6 feet. Unusually extensive thickets grow on open ridges paralleling the Horse Creek valley between Davis Ranch and Meadow. This shrub flowers early in June, but occasionally a little later. A flowering specimen from Steamboat Mountain was collected June 26, 1913. The distribution of *Cercocarpus parvi-*

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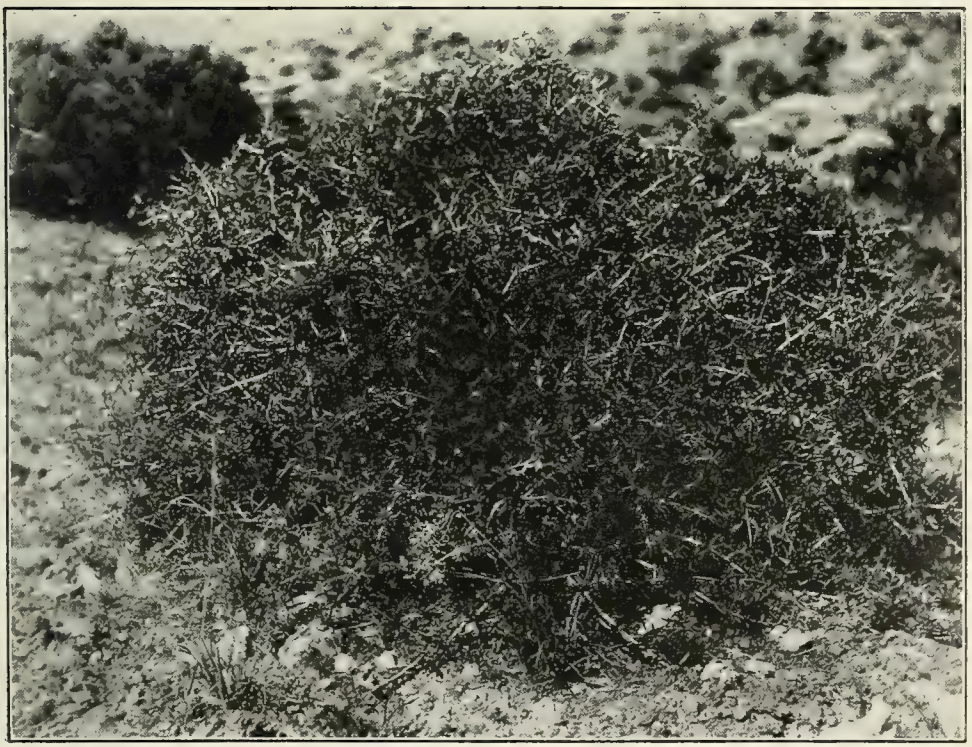
FIG. 1.—MOUNTAIN MAHOGANY (CERCOCARPUS INTRICATUS).

West slope of Bighorn Mountains above Hyattville (6,000 feet).



B11722

FIG. 2.—NEARER VIEW OF SAME.

folius as noted by Survey parties is entirely south of a line from Newcastle in the northeast to Evanston in the southwest.

Kunzia tridentata (Pursh) Sprengel. Antelope Brush.

The antelope brush is a common shrub on dry open Transition slopes in southern and western Wyoming, being especially abundant on arid hills, plateaus, and occasional sand ridges in the borders of the Red Desert at elevations between 7,000 and 8,500 feet. It was not noted north of the Wind River, Rattlesnake, and Casper Ranges, but it is not uncommon on dry slopes and sagebrush flats south of Buffalo Creek and the Gros Ventre River in Jackson Hole. With the sagebrush (*Artemisia tridentata*) this shrub regularly ascends warm slopes and occurs in dry parks and openings to the lower edge of the Canadian Zone. Its vertical range varies from 4,500 feet on ridges along the North Platte near Glendo to 9,000 feet on the summits of the Laramie and Ferris Ranges, and also on the warm southern slopes of the Wind Rivers north of Big Sandy.

Holodiscus dumosus (Nuttall) Heller.

Common locally on rocky slopes in some of the dry desert mountains and in the rougher borders of the Red Desert, mainly in the Transition Zone.

Opulaster pubescens Rydberg. Ninebark.

On dry, steep, basal mountain slopes at the head of Pat O'Hara Creek, northwest of Cody, the ninebark forms a low but exceedingly dense chaparral among partly dead Douglas spruce and white pine forests up to 6,500 feet elevation. Along the northern base of the Bighorn Mountains near Wolf it was likewise partial to dry slopes between 5,000 and 7,000 feet.

Opulaster monogynus (Torrey) Kuntze. Western Ninebark.

The western ninebark, a Transition Zone shrub, is tolerably common on the Laramie Mountains and on outlying ridges of the plains region to the eastward, at elevations between 5,000 and 7,000 feet.

Opulaster malvaceus (Greene) Kuntze. Ninebark.

This ninebark is very abundant and conspicuous on the warm western slopes of the Salt River Range near Afton, but was not found elsewhere. Its vertical range in these mountains is from their bases up to 7,100 feet in canyons and to 7,500 feet on warm slopes, and like the other Wyoming species of the genus it is mainly restricted to the Transition Zone.

Spiræa lucida Douglas. Meadowsweet.

The handsome flowering meadowsweet is sparingly present across Wyoming at the north in the lower part of the Canadian forest belt. Alexander Wetmore collected it at 7,000 feet elevation on the east side of Teton Pass on September 9, 1910, and I have observed it down to 5,800 feet in the Bighorn Mountains near Wolf, and in abundance on the Bear Lodge Mountains above 5,500 feet.

Vernon Bailey reports a pink-flowered species, probably *Spiræa densiflora*, between 7,000 and 8,000 feet on the eastern slope of the Bighorns, above Wolf.

Dryas octopetala Linnæus. Alpine Avens.

The low alpine avens is restricted to Arctic and Alpine regions. In Wyoming I collected it on the Bighorn Mountains, where it was in characteristic prostrate matted growth on the rocky slopes above timberline at the head of Trapper Creek, being not yet in flower on June 10, 1910. Vernon Bailey collected it in August, 1893, on the high Wind River Range at the head of Bull Creek.

Rubus deliciosus James. False Raspberry.

The handsome false raspberry was abundant and still flowering on the pine clad foothill ridges southwest of Wheatland on July 4, 1909, at elevations between 5,000 and 5,500 feet. This is probably near its northern limit, as it was not noted in the Laramie Peak region nor on any of the ranges farther west.

Rubus parviflorus Nuttall. Flowering Raspberry; Thimbleberry. (Fig. 13.)

The flowering raspberry is a tolerably common fruiting species in Canadian Zone woods on most of the Wyoming ranges, especially at the north. The large leaves, showy white flowers in June and early July, and in most years an abundance of handsome red berries in late August, make the thimbleberry very conspicuous in the woodlands between 7,000 and 9,000 feet elevation. The

B11645

FIG. 13.—Flowering raspberry (*Rubus parviflorus*) in cool gulch, north base of Casper Mountains (6,500 feet).

large berries, which are pleasantly flavored, though somewhat dry and seedy, are eaten by many native birds and mammals.

Rubus strigosus Michaux. Red Raspberry.

The red raspberry is abundant at numerous localities in the mountain districts from the lower edge of the forest belt to timberline. Its observed vertical range is from 4,500 feet at Wolf, at the north base of the Bighorn Mountains, to 11,700 feet, above timberline, south of Fremont Peak, Wind River Range. It reaches its best growth and bears most abundantly on rocky, partially forested slopes in upper Transition and lower Canadian Zones on the northwestern ranges. In the heavy forests between 7,000 and 8,000 feet elevation on Grinnell Creek, in the Absaroka Range, the fruit was just ripening on August 1, 1910, while on the western slope of the Salt River Range the bushes were full

of berries on August 20, 1911. In the timberline region the species occurs in a dwarfed state, usually not over a foot high in fields of slide rock. Rock-strewn paths of avalanches throughout the mountains support more or less raspberry growth.

Dasiphora fruticosa (Linnæus) Rydberg. Shrubby Cinquefoil.

The low shrubby cinquefoil inhabits cold mountain bogs and meadows and is more common on the ranges along the western edge of the State than farther east. It is especially abundant in the cold stream meadows along the northern base of the Uinta Mountains, in the upper Green River Basin, and at the head of Wind River; in the willow swamps of Jackson Hole and Yellowstone Park; and in the timberline region on the Wind River and Absaroka Ranges. It extends above timberline on deep-soiled slopes, but at the higher altitudes is depauperate, from a few inches to a foot in height.

Amelanchier alnifolia Nuttall. Serviceberry.

Several species of serviceberry are characteristic of the Transition Zone of Wyoming, but *Amelanchier alnifolia* appears to be of widest range. On the less arid foothills and lower mountain slopes at the east and north, where it is most abundant, it is usually the only species present, but in the central and southern districts it occurs in places with *A. oreophila*, *A. elliptica*, and possibly others.[1] Typical specimens are from the Bear Lodge Mountains. It was noted at localities too numerous for inclusion.

Amelanchier elliptica A. Nelson. Serviceberry.

Taken only in the southwest, where it is the predominating species of *Amelanchier* in the western Transition borders of the Red Desert region at elevations up to 8,000 feet. It was observed at a number of points on the Bear River Divide from Hilliard north to Cokeville, and also in the badlands south of Lyman. S. G. Jewett collected flowering specimens at Spring Valley on June 9, 1912, and also on Steamboat Mountain on June 25.

Cratægus cerronis A. Nelson. Hawthorn.

Several species of hawthorn are represented in Wyoming, where they form a characteristic fringe on streams in the Transition Zone. *Cratægus cerronis* is apparently the predominating form in the Bighorn Mountains, and possibly east to the Black Hills. It was blooming profusely on June 6, 1912, in the heavy deciduous fringe along Wolf Creek, at the northern base of the Bighorns, up to 4,800 feet.[2] Flowering examples were collected at this point.

Cratægus rivularis Nuttall. Black Hawthorn.

The black hawthorn is common in southwestern Wyoming north to the Salt River Valley and Green River Basin and east at least to the upper Platte, at elevations from 6,000 to 8,000 feet.

Sorbus scopulina Greene. Mountain Ash.

In the Wyoming ranges the mountain ash is usually a low or medium-sized shrub 3 or 4 feet high, growing in scattered clumps or occasionally forming small thickets, although in the Shirley Mountains a few clumps 6 feet or more in height were noted. It is very generally distributed in the forests of the Canadian Zone up to 8,500 or 9,000 feet altitude.

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[1] Data collated under *Amelanchier alnifolia* may include some related to other species, being based mainly on field identifications. Unfortunately, few specimens of *Amelanchier* have been preserved.

[2] Vernon Bailey found the hawthorn up to 6,000 feet near Wolf.

Prunus americana Marshall. Wild Red Plum.

Scattered scrubby thickets of wild red plum are met with in gulches and on streams of the northeastern counties east of the Bighorn Mountains, the species being perhaps most abundant on the basal slopes of the Bear Lodge Mountains and at the northern base of the Black Hills.

Prunus pennsylvanica Linnæus f. Wild Red Cherry.

The wild red cherry is sparingly present in northern Wyoming from the upper slopes of the Black Hills and Bear Lodge Mountains west nearly to Yellowstone Park. On the dry, partially open summit of the Bear Lodge Mountains it grows in a dwarfed state. Shrubs not over 2 feet high were flowering profusely at 6,000 feet altitude on June 20, 1912, and considerable fruit was found by Vernon Bailey near Welcome late in August, 1913. Fruit was reddening at the end of July, 1910, on the North Fork of the Shoshone River.

Prunus melanocarpa (A. Nelson) Rydberg. Chokecherry.

The chokecherry is the predominating species of *Prunus*, being omnipresent in the foothills and mountains below 8,000 feet elevation, and on the Laramie Range reaching 9,000 feet. It is most abundant on dry, open, or partly forested Transition Zone slopes, where, however, it occurs usually in low scraggy thickets. It attains its perfection in damp gulches and along streams. The fragrant white bloom is conspicuous in May and early in June.

Amorpha canescens Pursh. False Indigo.

The low silvery false indigo, a shrub of the open Great Plains area, barely enters the State at the northeast in the Belle Fourche Valley. In June, 1912, it was common near Aladdin on open grassy slopes bordering Hay Creek valley.

Rhus rydbergi Small. Western Poison Ivy.

The western poison ivy was occasionally noted at the eastern base of the mountains: base to summit of Rawhide Butte, near Lusk; and Wolf Creek, Bighorn Mountains, below Eaton's Ranch.

Schmaltzia glabra (Linnæus) Small. Smooth Sumac.

The smooth sumac was noted by Vernon Bailey on the lower eastern slopes of the Bighorn Mountains near Wolf, August 10, 1913. It was sparingly present between 4,000 and 6,000 feet elevation in this locality, but has not been noted elsewhere in Wyoming by Survey field parties.

Schmaltzia trilobata (Nuttall) Small. Skunk Bush.

The skunk bush, characteristic of the Upper Sonoran Zone, fringes watercourses at the lower elevations up to 5,000 or 6,000 feet, and on especially warm slopes has been noted at a little over 7,000 feet. The heaviest growth is along streams, as at Greybull, where there are dense thickets 8 or 10 feet high in the cottonwood growth along the Bighorn. A scrubby growth clothes the hot slopes in the bad lands between Greybull and Ionia to a considerable elevation. On Horse Creek north of Cheyenne, and also near Wheatland and Cassa, it grows on valley flats with sagebrush. In the warm districts generally it occurs in scattering growth in dry gulches and on exposed faces of bluffs.

Pachystima myrsinites (Pursh) Rafinesque.

A low evergreen shrub of the Canadian forest belt in Wyoming, chiefly in the western and southwestern mountains. Its vertical limits are approximately 6,000 and 10,000 feet, but it is most abundant between 7,000 and 9,000 feet. On the Salt River Range near timberline it was growing abundantly in a

dwarfed state a few inches high. The small green flowers appear quite early, the flower buds being evident on a specimen collected at Jackson, May 4, 1911, by Edward A. Preble.

Acer negundo Linnæus. Box Elder.

The box elder was noted chiefly along streams and in wet draws of the Great Plains area, but also at Bonanza in the Bighorn Basin, and between Dixon and Baggs along the southern boundary of the State.

Acer glabrum Torrey. Mountain Maple.

The handsome mountain maple inhabits cool slopes, gulches, and damp spots generally from the base of the mountains to 8,000 or 9,000 feet elevation, being most abundant in southeastern Wyoming. It was not noted in the Black Hills region, although found sparingly in cool north gulches at Squaw Butte, on the Wyoming-Nebraska line east of Kirtley. Its usual height is 5 or 6 feet in the mountains, and it rarely exceeds 8 feet even along streams.

Acer grandidentatum Nuttall. Large-Toothed Maple.

Scattered clumps of the large-toothed maple, 10 or 12 feet in height, are on the warm lower western slopes of the Salt River Range near Afton. The vertical range in these mountains is from their 6,300-foot bases up to 7,300 feet, in the Transition Zone, and it does not here attain its maximum growth. On the Salt River Range it is associated with the mountain maple, but does not occur as high as the latter.

Rhamnus alnifolia L'Heritier. Buckthorn.

The buckthorn reaches a short distance into Wyoming at the west, in the region contiguous to Snake River, but was not detected elsewhere. It is a conspicuous shrub on stream margins and in wet willow bottoms in the borders of Jackson Hole, and was abundant on Pacific Creek, 15 miles northeast of Moran. It was bearing its large ripe black berries in Webb Canyon in the Teton Mountains, at 6,700 feet elevation, September 1, 1910, and was collected by Alexander Wetmore on Trail Creek, near Teton Pass, late in September.

Ceanothus velutinus Douglas. Mountain Balm. (Fig. 14.)

Throughout the mountains one of the most characteristic shrubs is the mountain balm, in many places forming a dense chaparral 2 or 3 feet high on dry, open or partly forested slopes mainly in the Transition Zone. It was found in greatest abundance on dry summits of medium elevations, as the Bear Lodge, Casper, Shirley, Ferris, and Rattlesnake Mountains, on the 8,000-foot divide between the head of Salt River and Smiths Fork, and on Little Mountain, the elevated plateau between Maxon and the Green River Valley. The vertical limits are from 5,000 feet near Wolf, at the eastern base of the Bighorn Mountains, to 9,500 feet on Bridger Peak in the Sierra Madre. The white, sweet-scented flowers were conspicuous in Sierra Madre forests west of Grand Encampment between 8,500 and 9,500 feet, July 7, 1911, and the species was still in partial flower on the Wind River Range north of Big Sandy July 26, although past flowering near Fremont Lake on the same range by July 20.

Ceanothus fendleri Gray. Wild Tea Bush.

The low, much-branched wild tea bush is common on dry, warm slopes near Springhill, north of Laramie Peak. It was found in open yellow-pine forest up to 7,400 feet elevation, but was not noted elsewhere within the State.

Ceanothus mollissimus Torrey. Wild Tea Bush.

Vernon Bailey found this wild tea bush on Big Goose Creek, at the eastern base of the Bighorn Mountains. It is apparently rare in Wyoming.

Elæagnus argentea Pursh. Silverberry.

The silverberry occurs across Wyoming at the west, where it forms a scattering silvery fringe on stream banks mainly in the Transition Zone. It is especially abundant on streams of the upper Green River Basin and on tributaries of Wind and Snake Rivers. Elsewhere it was observed at Maxon, Lonetree, Cokeville, Meeteetse, on the South Fork of the Shoshone River, Pat O'Hara Creek, and on Gardiner River, near Mammoth Hot Springs.

Lepargyrea argentea (Nuttall) Greene. Buffaloberry.

While abundant locally on many streams at the base of the mountains, especially at the north, the buffaloberry is by no means generally distributed over the State, and was not detected in the southwest. The localities where it was

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FIG. 14.—Mountain balm (*Ceanothus velutinus*) in flower, Sierra Madre, July 7, 1911 (9,000 feet).

found are mainly Upper Sonoran: Sibylee Creek, Casper, Belle Fourche River, Little Missouri River, Powder River, Clear Creek, streams near Sheridan and Ranchester, up Wolf Creek to 4,500 feet elevation, Alcova, Casper Creek, north slope Rattlesnake Mountains, Snake River at Baggs, Wind River Basin (mainly below 6,000 feet), and streams of Bighorn Basin.

Lepargyrea canadensis (Linnæus) Green. Canadian Buffaloberry. (Fig. 15.)

The Canadian buffaloberry is a characteristic and widely distributed undershrub in the forests of the Canadian Zone between 8,000 and 10,000 feet elevation. Although usually found on mountain slopes, it is abundant in balsam poplar growth along Snake River and other streams of Jackson Hole.

Phyllodoce empetriformis (Smith) Don. Mountain Heath.

The mountain heath, a characteristic evergreen of the Hudsonian Zone, was found locally abundant at widely separated localities in the high ranges of

northwestern Wyoming. Near Fremont Peak it was abundant in bogs and rocky situations from 10,500 feet altitude to a little above timberline, and occasional at 10,000 feet. On July 20 the dainty rose-colored flowers were still open on the Wind River Mountains, but on August 1 it was nearly through flowering on Whirlwind Peak, in the Absaroka Range. At timberline on the Tetons no flowers remained on the branches by August 30.

Menziesia ferruginea Smith. Rustyleaf.

This handsome and conspicuous shrub was observed only in the dense coniferous forests of Yellowstone Park, where it is common near Sylvan Pass,

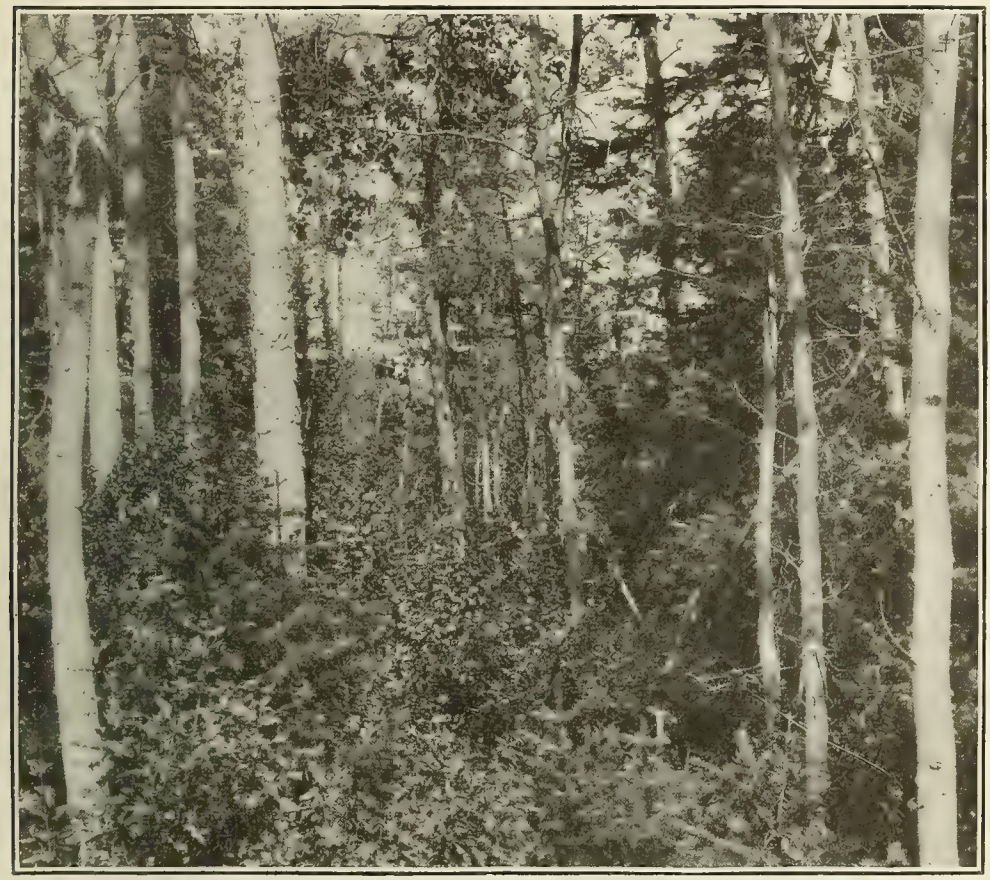

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FIG. 15.—Canadian buffaloberry (*Lepargyrea canadensis*) in aspen woods, Wyoming Range near Merna (8,000 feet).

Lone Star Geyser, below Norris Basin, Thumb, Lewis River, and Snake River near Soldier Station.

Kalmia polifolia Wangenheim. Laurel.

The wet bogs and mossy margins of the numerous snow-fed lakes on the Wind River Range south of Fremont Peak were bright with pretty pink-purple flowering mats of laurel in mid-July, 1911. The species was in flower on July 18 in the Hudsonian Zone from 10,000 to 11,000 feet elevation, but was not detected above timberline. With *Phyllodoce empetriformis* it often formed dense mats, from a few inches to nearly a foot in height. Vernon Bailey collected the laurel in the timberline region on the Wind River Mountains above Bull Lake in 1893, and at the head of Raven Creek, in Yellowstone Park, in 1915.

Arctostaphylos uva-ursi (Linnæus) Sprengel. Red Bearberry.

The low trailing red bearberry, with its leathery evergreen leaves, dainty rose-hued blossoms, and red berries, forms beautiful mats in the open yellow pine forests of the Black Hills, Laramie Peak region, and on the eastern slopes of the Bighorn Mountains. While most abundant in the Transition Zone, it occurs occasionally in the coniferous forests higher up, as on the upper slopes of Laramie Peak and on the Wind River Range south of Dubois. It is very abundant in the woodlands of Jackson Hole, and also on the Bear Lodge Mountains; at from 5,000 to 8,000 feet elevation on the eastern slope of the Bighorn Mountains near Wolf; and from 8,000 to 9,500 feet on their western slope above Hyattville; on the Rattlesnake, Shirley, and Green Mountains; south of Fremont Peak and on the head of the Big Sandy, Wind River Range; Needle Mountain and Grinnell Creek, Absaroka Range; Merna; Evanston; and north slopes of Uinta Mountains west of Lonetree.

Vaccinium oreophilum Rydberg. Mountain Blueberry.

The mountain blueberry reaches perfection of growth in the cool, damp forests of the Canadian Zone at about 8,000 feet elevation. In many localities it occurs with *Vaccinium erythrococcum*, but it is less abundant and usually not found so high up. It was observed on the Bear Lodge, Shirley, Casper, Ferris, and Bighorn Mountains; Grinnell Creek, Absaroka Range; forests of Yellowstone Park; Teton Pass and Moose Creek, Teton Range; wooded hills bordering Jackson Lake; head of Pacific Creek; Snake River west of Jackson; Salt River Range near Afton; and on the Wyoming Range near Merna.

Vaccinium erythrococcum Rydberg. Red Bilberry. (Pl. IX, fig. 2.)

The low, small-leaved red bilberry was noted on all the higher elevations of Wyoming. It is most abundant in the upper Canadian Zone, where it densely carpets the coniferous forest floor, and it is the only *Vaccinium* present in the Hudsonian belt of dwarfed forest higher up. In early August the small juicy red berries are greatly relished by dusky grouse and other forest birds.

Vaccinium occidentale Gray. Western Blueberry.

The shrubby western blueberry was encountered in northwestern Wyoming, from Lewis Lake, Yellowstone Park, south to Jackson Lake, and east on the Wind River Range to Fremont Peak. It attains a height of nearly 2 feet in Yellowstone Park, growing in dense clumps in lodgepole pine forests between 7,000 and 8,000 feet elevation. Its small blue berries were ripe south of Lewis Lake on August 18, 1910. South of Fremont Peak it was growing in bogs a little below timberline, at 10,500 feet.

Fraxinus lanceolata Borckhausen. Green Ash.

The green ash occurs sparingly in the low stream valleys of extreme eastern and northern Wyoming west to the base of the Bighorn Mountains. It was found at Newcastle; Sand Creek to 10 miles above Beulah; Hay Creek to Aladdin and Eothen; groves on the Belle Fourche flats at Devils Tower; Little Missouri River; gulches near Morse; Powder River near Montana boundary; Prairie-dog Creek; Sheridan; Big Goose Creek; Wolf Creek, to 4,500 feet elevation, near Eaton's Ranch.

Sambucus microbotrys Rydberg. Red Elderberry. (Fig. 16.)

The red elderberry is a characteristic shrub of the Canadian Zone coniferous forest on the main ranges of Wyoming. Usually it is the only elderberry present on the higher slopes, but lower down occurs with its black-fruited relative,

Sambucus melanocarpa. The red elder was not taken in the foothill ranges of eastern Wyoming nor in the Bighorn Mountains, but it has a general distribution from 7,000 to 9,500 feet elevation in the mountains farther west.

Sambucus melanocarpa Gray. Black Elderberry.

The black elderberry is of lower vertical range than the red species, occurring mainly in the Transition Zone, and from our observations was not so generally distributed. It was noted on Laramie Peak, north slope, rare at 8,000 feet elevation; Shirley Mountains, north escarpment, 7,600 feet to summit; Ferris Mountains, in dense coniferous forest, 8,000 to 9,000 feet; Salt River Range, 7,000 feet. Vernon Bailey found it bearing ripe berries on August 10, at 7,500 feet, on a southwest slope in the Bighorn Mountains near Wolf.

B13632

FIG. 16.—Red elderberry (*Sambucus microbotrys*) in bloom, Sierra Madre, July 7, 1911 (10,000 feet).

Sambucus canadensis Linnæus. Elderberry.

The large elderberry, *Sambucus canadensis*, was detected only at the southern base of the Bear Lodge Mountains near Sundance, in the Transition Zone. Its handsome flat-topped cymes of white flowers were very conspicuous in the canyon along Sundance Creek, at 4,700 feet elevation, on June 20, 1912.

Viburnum lentago Linnæus. Sweet Viburnum.

Vernon Bailey found the sweet viburnum not uncommon in August, 1913, in the shaded canyons and gulches along Sand Creek above Beulah, at the northern base of the Black Hills. He also reports it from the Belle Fourche Valley near Devils Tower, and along Big Goose Creek at the east base of the Bighorn Mountains.

Symphoricarpos occidentalis Hooker. Wolfberry.

The wolfberry occurs over much of the Upper Sonoran Great Plains area, forming dense thickets 2 feet in height in gulches and along streams, and in many localities constituting the principal shrubby growth. The species regularly extends west to the bases of the Laramie and Bighorn Mountains, and was found also in Wind River Basin, and at the eastern base of the Absaroka Range northwest of Cody.

Symphoricarpos pauciflorus (Robbins) Britton. Few-Flowered Snowberry.

The few-flowered snowberry is higher ranging than the wolfberry (*Symphoricarpos occidentalis*) and occurs mainly in the Transition Zone in northern Wyoming. It was recorded at various altitudes from 4,700 feet to 8,500 feet in the Bear Lodge, Bighorn, Absaroka, and Wyoming Ranges.

Symphoricarpos oreophilus Gray. Mountain Snowberry.

The mountain snowberry is the predominating species of its genus in Wyoming, where it is rarely absent from dry, rocky, open, or partly forested slopes and ridges in the Transition Zone. On some of the southern and western ranges it is common on exposed points in dry forest openings up to 9,000 feet elevation. This shrub enters the lower portions of Yellowstone Park at the north and south, and occurs in the open sections of Jackson Hole.

Symphoricarpos rotundifolius Gray. Round-Leaved Snowberry.

The round-leaved snowberry is apparently uncommon. It is represented by a specimen from Rawhide Butte, taken July 23, 1909, where scattering bushes were noted from base to summit in the Transition Zone.

Lonicera glaucescens Rydberg. Douglas Honeysuckle.

The Douglas honeysuckle reaches Wyoming in the extreme northeast, where it is found sparingly along streams and on damp slopes above 4,700 feet elevation near Sundance, in the Bear Lodge Mountains.

Lonicera utahensis Watson. Utah Honeysuckle.

The Utah honeysuckle abounds in the mountain forests of extreme western and northwestern Wyoming. From the forests of Yellowstone Park, where it is especially abundant, it occurs south at least to the Salt River Mountains, reaching its upper limits on the western slope of this range at 9,000 feet elevation, and on the eastern slope of the Teton Range at about 8,000 feet.

Lonicera involucrata Banks. Involucred Fly Honeysuckle.

In Wyoming the involucred fly honeysuckle occurs commonly in all the principal ranges with the possible exception of the Bighorn Mountains. It becomes increasingly abundant westward, and is one of the most characteristic shrubs on the banks of cold streams up to 8,000 or 9,000 feet elevation in the Canadian forest belt, ripening its blackish berries about the first of August.

Chrysothamnus graveolens (Nuttall) Greene. Rabbit Brush.

The plains, deserts, and basal mountain slopes of Wyoming are rich in species of *Chrysothamnus*, some of them among the best characterizing shrubs of the Upper Sonoran or Transition Zones. The meager data secured by Survey parties relates mainly to species which are of importance in determining life zones. *C. graveolens* is a conspicuous shrub, often several feet high, growing in Upper Sonoran gulches, desert arroyos, and on dry slopes, principally in eastern and northern Wyoming. It is especially abundant on flats along Bighorn River in the lower portions of the Bighorn Basin. The species occurs at Cassa; Fort Fetterman; Casper; along the North Platte near Alcova; Hay Creek east of

Aladdin; Wind Creek northeast of Moorcroft; Buffalo; gulches at south base of Owl Creek Mountains; Badwater River north of Shoshoni; Worland; Manderson; Greybull; Frannie to Garland; and east of Cody.

Chrysothamnus linifolius Greene. Rabbit Brush.

Like *Chrysothamnus graveolens*, this species is a fair-sized shrub, inhabiting principally the cut banks of adobe along desert washes and streams in the Upper Sonoran Zone, as along Bear Creek, south of Cassa; Rock Springs; and warm pockets along Green River between Fontenelle and Labarge. Vernon Bailey collected a specimen at Arvada, on Powder River, August 13, 1913. Nelson found the species at Point of Rocks and Granger.[1]

Chrysothamnus plattensis Greene. Rabbit Brush.

Chrysothamnus plattensis is a low, spreading Upper Sonoran species of rabbit brush of the North Platte and tributary valleys at the southeast. It was noted up to 6,200 feet elevation on Horse Creek, near Meadow, and also at Snow's Ranch, on Rawhide Creek below Patrick.

Chrysothamnus stenophyllus Greene. Rabbit Brush.

This is a common species of rabbit brush over most of the sandy plains and ridges of central Wyoming, in the Upper Sonoran Zone, as at Casper, Efell, and in Sweetwater Valley from Independence to Splitrock. Nelson records it from Point of Rocks, on the Red Desert.[1]

Chrysothamnus stenophyllus Greene. Rabbit Brush.

This species was taken in the Upper Sonoran Zone in the Belle Fourche Valley at Moorcroft, August 15, 1913, by Vernon Bailey.

Chrysothamnus howardi (Parry) Greene. Rabbit Brush.

A specimen of *Chrysothamnus howardi* was collected by Vernon Bailey at Arvada, on Powder River, August 13, 1913. It is usually of the higher plains.

Chrysothamnus wyomingensis A. Nelson. Rabbit Brush.

Mainly of the high Transition plains and basal mountain slopes at the north. It is very abundant at the northern base of the Bighorn Mountains at Wolf, where a specimen was collected on June 6, 1912, and is apparently the species so abundant on the basal slopes of the Bear Lodge Mountains. Vernon Bailey collected it at Arvada, on Powder River.

Chrysothamnus pulcherrimus A. Nelson. Rabbit Brush.

This rabbit brush is common in the Transition Zone on the high central plains and in the upper Green River Basin, growing on open slopes with sagebrush regularly to 8,000 feet altitude. It is especially abundant on both slopes of the mountains near Laramie Peak, on the northern Laramie Plains, and in Shirley Basin. It was noted along Little Medicine Bow River west of Marshall at 7,000 feet.

Artemisia tridentata Nuttall. Black Sagebrush. (Fig. 17.)

The most widely distributed shrub in Wyoming is the black sagebrush. It is omnipresent in open country east to the edge of the Great Plains, where its eastern limits are marked by Orin Junction (North Platte Valley), Lost Spring, Indian Creek north of Kirtley at State line, Clifton, Newcastle, Wind Creek northeast of Moorcroft, and Colony. It was not found east of the Laramie Mountains in southeast Wyoming. From 4,000 feet elevation at the east this

[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 66, 1898.

sagebrush extends to timberline on some of the ranges, attaining 9,800 feet on the Bighorns above Hyattville, and 10,000 feet on the Wind Rivers south of Dubois and on the Wyoming Range west of Bigpiney and Merna.

Artemisia cana Pursh. Gray Sagebrush.

The gray sagebrush is generally dispersed and especially common in the mountain valleys and parks, but less abundant than the black species. It extends into the edge of the Great Plains area. In the valleys east of the Laramie Mountains this is usually the only shrubby sage present, and it forms much of the scattering growth on the open stretches between the Black Hills and Bighorn Mountains. Westward it rapidly gives way to the black sagebrush.

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FIG. 17.—Black sagebrush (*Artemisia tridentata*) 10 feet high, upper Wind River Valley.

Artemisia trifida Nuttall. Sagebrush.

A small shrubby sage, sparingly present in open Transition country chiefly at the west, as on the summit of the Owl Creek Mountains; Bear River Divide north of Evanston, 7,500 feet elevation; benches above Cokeville; and Salt River Valley. Vernon Bailey found the species in open parks in the mountains south of Douglas, near Valley, and in Jackson Hole.

Artemisia filifolia Torrey. Narrow-Leaved Sagebrush.

The narrow-leaved sagebrush is a characteristic shrub of the Great Plains Sonoran area, occurring in the North Platte drainage chiefly in sandy tracts as far west as Guernsey. A very dense growth 2 or 3 feet high covers the Rawhide flats at Snow's Ranch south of Patrick, and it is abundant in the sandy valley of the Chugwater east of Wheatland.

Artemisia arbuscula Nuttall. Brown Sagebrush.

The brown sagebrush is uncommon, according to the author's observations. Vernon Bailey reports it at Hams Fork Station (Moyer Junction) and Valley, and collected specimens on the Owl Creek Mountains in 1893 and in Salt River Valley on August 15, 1911, all Transition Zone localities in western Wyoming.

Artemisia spinescens Eaton. Spiny Sage; Bud Brush.

A low spinescent shrubby sage, abundant at many localities in the Upper Sonoran desert region at the southwest. It is common, also, on sandy benches near Shoshoni and in the lower parts of the Bighorn Valley near Greybull and Manderson. It occurs at many stations with the less shrubby *Artemisia pedatifida*, with which it is sometimes confused.

Artemisia frigida Willdenow. Pasture Sage.

The pasture sage, a low silvery sage, is scarcely a shrub, but is included as a characteristic Transition species of the genus. It has a very wide range over Wyoming on high plains, bare ridges and plateaus, and open mountain slopes generally.

Tetradymia spinosa Hooker and Arnott. Spiny Rabbit Brush.

The members of the genus *Tetradymia* are characteristic shrubs of the Great Basin Division of the Upper Sonoran Zone, and do not enter the Great Plains area. They occur in varying abundance and scattered bunchlike growths over the dry hills and plains of the arid central desert section, from the Green River Valley and Red Desert north to the Bighorn Basin.

Tetradymia spinosa is the more widely distributed species below 6,500 feet altitude. It is common at Green River, Superior, Rock Springs region, warm river flats (Fontenelle to Labarge), sand flats north of Opal, Shoshoni, Worland, Bonanza, Manderson, Greybull to Cody, and Frannie to Garland.

Tetradymia nuttalli Torrey and Gray. Nuttall Rabbit Brush.

The Nuttall rabbit brush is more spiny than the preceding species. It was collected only at Fort Steele, where it was abundant in the warm, lower parts of the North Platte Valley. Nelson mentions specimens from Bitter Creek and Green River.[1]

Tetradymia inermis Nuttall. Rabbit Brush. (Pl. VII, fig. 2.)

This high-ranging rabbit brush grows abundantly on the sandy plains of the upper Green River Basin to an elevation of 7,500 feet. It was not found at the lower levels, but was common on sand flats at Eden and Big Sandy and also on Little Piney Creek. Nelson collected specimens at Bitter Creek on the Red Desert.[1]

[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 67, 1898.

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